





RECORDS OF THE AUSTRALIAN MUSEUM

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A. G. BEU AND W. F. PONDER

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ABSTRACT

All Australian and New Zealand fossil taxa and all world living taxa are revised in the genus *Bolma* Risso (= *Oobolma* Sacco, = *Ormastraliu*m Sacco, = *Tylastraliu*m Sacco, = *Pseudastraliu*m Schepman, = *Incilaster* Finlay, = *Galeoastraea* Habe, = *Hirasazaea* Habe). The genus is contrasted with related genera using shell and radular characters, and all recognised taxa in *Bolma* are diagnosed and figured. New taxa named are *Bolma anacanthos* n. sp., Oligocene, Victoria; *B. austroconica* n. sp., Oligocene, Victoria; *B. flindersi darraghi* n. subsp., Upper Eocene, Victoria; *B. kermadecensis* n. sp., Recent, Kermadec Islands; *B. somaliensis* n.sp., Recent, East Africa; and *B. tamikoana flava* n. subsp., Recent, Malagasy Republic. *Senobolma* Okutani, 1964 is ranked as a subgenus of *Bolma* Risso. Living taxa newly recorded from Australia are *B. guttata millegranosa* (Kuroda & Habe), *B. guttata* subsp?, *B. henica* (Watson), and *B. tamikoana tamikoana* (Shikama).

INTRODUCTION

The gastropod genera related to *Astraea* Röding (*Bolma* Risso, *Astraliu*m Link, *Guildfordia* Gray, *Lithopoma* Gray, *Pomaulax* Gray, etc.) have smooth surfaces or finely to coarsely gemmate sculpture, a very low to very prominent row (or rows) of peripheral spines that in many species are situated on a weak to marked peripheral angulation, and heavy calcareous opercula that place them in the family Turbinidae. They are often included in a separate subfamily *Astraeinae* (= *Bolmidae* Delpey, 1942, p. 181) but several typical turbinids have granular sculpture (e.g., *Modelia granosa* (Martyn), New Zealand; *Euninella gruneri* (Philippi), South and south Western Australia) and some species of *Turbo* Linné have a row of peripheral spines (e.g., *Turbo* (*Batillus*) *cornutus* (Solander in Lightfoot), in which peripheral spines may be absent or small to very large). The opercula of most "*Astraeinae*" are oval, whereas most Turbininae have circular opercula. The opercula of species of *Bolma* are oval, circular or intermediate in shape. Apart from the enigmatic Triassic genus *Rothpletzella* Bohm, 1895, (Knight *et al.* 1960, p.1264, fig. 170, 1) both the "subfamilies" Turbininae and *Astraeinae* are known earliest in Upper Cretaceous rocks (Knight *et al.* 1960). In the absence of any distinguishing shell characters other than that many members have a peripheral angulation, and of any difference in stratigraphic range, and because of the intergrading opercula features, we do not recognise a subfamily for the genera related to *Astraea*.

The genera related to *Astraea* are difficult to diagnose on shell and opercular features alone. Fortunately the radulae have been described for a number of species. Radulae of several further species are described below, and all these help to clarify the generic groupings. The most recent reviewers, Knight *et al.* (1960), oversimplified the situation by reducing nearly all of the proposed genera to subgenera of *Astraea*. They allowed *Guildfordia* Gray as a separate genus, of which they ranked *Pseudastridium* Schepman as a subgenus, following Habe (1957, p. 208).

Species of *Bolma* are sometimes difficult to define because usually few specimens from any one population have been available for study. Consequently the limits of both population and geographic variation have been difficult to assess. For this study, material of *Bolma* in many world museums has been either studied at the museums or borrowed.

Almost nothing is known of the biology of species of *Bolma* although it is assumed that they have at least a short planktonic larval life and probably do not graze on attached algae because most species live well below the limits of algal growth. Wide distribution might be expected in animals exhibiting a free-swimming larval stage and inhabiting a subtidal environment, but this is apparent in only a few species. Two species as here interpreted, *B. henica* (Watson) and *B. guttata* (A. Adams), range from Japan to South Africa and Australia but the latter species shows a number of geographical forms over its range which are here regarded as subspecies.

Some details of the anatomy of the type species of *Bolma*, *B. rugosa* (Linné), have been published by Haller (1883) and Simroth (1892-1907).

Abbreviations

In the lists of localities, the following abbreviations have been used for some institutions holding the listed specimens:

AM	— Australian Museum, Sydney.
AMNH	— American Museum of Natural History, New York.
ANSP	— Academy of Natural Sciences, Philadelphia
BMNH	— British Museum (Natural History), London
DMNH	— Delaware Museum of Natural History, Greenville
NM	— Natal Museum, Durban
NMV	— National Museum of Victoria, Melbourne
NMW	— National Museum of Wales, Cardiff
NSMT	— National Science Museum, Tokyo
NZGS	— New Zealand Geological Survey, Lower Hutt
NZOI	— New Zealand Oceanographic Institute, Wellington.
SAM	— South African Museum, Cape Town.
USNM	— United States National Museum, Washington, D.C.
WAM	— Western Australian Museum, Perth

TAXONOMY

Family Turbinidae

In order that our concept of *Bolma* may be more fully appreciated the diagnostic features of the genus are contrasted with those of the other taxa of the *Astraea* group that are here considered to be of generic rank.

Astraea Röding, 1798, p. 69 (type species (subsequent designation, Suter, 1913): *Trochus imperialis* Gmelin, 1791 = *Trochus heliotropium* Martyn, 1784, valid I.C.Z.N. Opin. 479) is a distinctive group of Turbinidae with a low spire, a widely open umbilicus, a narrowly reflected inner-lip callus, and a relatively thin, flat operculum. In New Zealand, the living *A. heliotropium* (Martyn) has a fossil history in late Lower Miocene to Pleistocene rocks, *A. bicarinata* Suter, 1917 occurs in Lower Miocene rocks, and 3 unnamed species occur in Upper Eocene, Oligocene, and early Miocene rocks. In Australia, *A. johnstoni* (Pritchard, 1896) occurs in Upper Eocene rocks, *A. hudsoniana* (Johnston, 1888) occurs in early Miocene rocks, and a species from Upper Miocene rocks is unnamed. Only these eight species belong in *Astraea* (sensu stricto).

Astralium Link, 1807, p. 135 (type species (monotypy): *Astralium deplanatum* Link, 1807 = *Turbo calcar* Linné, 1758) is a low-spined to very high-spined group having sculpture of major radial folds or ribs which are sometimes produced into short spines, a completely closed umbilicus, a flat, smooth operculum, and the basal callus usually narrow and separated from the columella. Genus-group names that may be synonyms of *Astralium* or may in some cases prove to be subgenera are: *Calcar* Montfort, 1810, p. 135 (type species (by monotypy): *Calcar sporio* Montfort, 1810 = *Turbo calcar* Linné, 1758); *Cyclocantha* Swainson, 1840, p. 348 (type species (by subsequent designation, herein): *Turbo calcar* Linné, 1758); *Stella* Herrmannsen, 1849, p. 501 (type species (by original designation): *Trochus stella* Lamarck, 1822); *Distellifer* Iredale, 1937, p. 249 (type species (by original designation): *Distellifer wallisi* Iredale, 1937, = *Trochus rhodostomus* Lamarck, 1822); *Pagocalcar* Iredale, 1937, p. 249 (type species (by original designation): *Trochus pileolum* Reeve, 1842, ? = *Trochus limbiferus* Kiener, 1850); *Rugastella* Iredale, 1937, p. 249 (type species (by original designation): *Trochus rotularius* Lamarck 1822); *Bellastraea* Iredale, 1924, p. 232 (type species (by original designation): *Bellastraea kesteveni* Iredale, 1924); *Micrastraea* Cotton, 1939, p. 169 (type species (by original designation): *Trochus aureus* Jonas, 1844).

Another distinctive group is the American and Japanese genera or subgenera closely related to *Lithopoma* Gray, 1850, p. 88 (type species (monotypy): *Trochus tuber* Linné, 1767). Included in the group are *Pachypoma* Gray, 1850, p. 88 (type species (subsequent designation, Fischer, 1873): *Trochus caelatus* Gmelin, 1791); *Pomaulax* Gray, 1850, p. 87 (type species (subsequent designation, Fischer, 1873): *Trochus japonicus* Dunker, 1845); *Uvanilla* Gray, 1850, p. 87 (type species (subsequent designation, Fischer, 1873): *Trochus unguis* Wood, 1828); and *Megastraea* McLean, 1970, p. 71 (type species (original designation): *Trochus undosus* Wood, 1828). They are similar in their medium to large size, moderate to tall spires with conic to markedly convex-whorled spire outlines, smooth or only weakly folded shell surface, relatively low, rounded peripheral folds to almost absent peripheral sculpture, and inflated or spirally sculptured opercula. The spirally ridged opercula bear granules or spines. They do not seem closely related to other genera of the *Astraea* group, and are separated from them by their relatively smooth surfaces, lack of a spreading basal callus, separation of callus from columella, and distinctive opercula.

Cookia Lesson, 1832, pl. 15 (type species (monotypy): *Trochus sulcatus* Martyn, 1784; valid I.C.Z.N. Opin. 479) has some similarity to *Pachypoma* and *Pomaulax* in shell and radular features but differs in having a smooth operculum with a strong spiral margining rib, and with a second short rib emerging from the nucleus. The radula differs from that of *Bolma* in having more massive marginal teeth and a relatively smaller central tooth with a central peg extending markedly beyond the upper margin of the tooth (Hutton, 1883, p. 125, pl. 14, fig. P; see also below and fig. 16g-i). This closely resembles the radula of *Lithopoma* figured by Pilsbry (1888, p. 61, fig. 11). Some species of *Bolma*

(e.g. *B. aureola* (Hedley)) approach *Cookia sulcata* in form and sculpture, and the uncoloured basal callus pad of *Cookia* is very similar to that of *Bolma*. Because of the radular and shell similarities to the *Lithopoma* group, we regard *Cookia* as a subgenus of *Lithopoma*.

Guildfordia Gray, 1850, p. 87 (type species (monotypy): *Astraliium triumphans* Philippi, 1841) has a relatively low spire, sculpture of fine, low, closely spaced gemmae ending immediately above the row of peripheral nodules or spines, a very finely sculptured to smooth base, the centre of which is covered by a callus pad with a marked central depression, and a flat, relatively thin operculum. Some relatively short-spined species such as *Astraliium* (*Guildfordia*) *moniliferum* Hedley and Willey, 1896 from New Britain (Hedley and Willey, 1896) have all the features of *Guildfordia* except long spines, and we can see no reason why they should not be placed there.

Opella Finlay, 1926, p. 368 (type species (original designation): *Astraea subfimbriata* Suter, 1917) is a highly distinctive group with a moderate to tall, conical, flat-sided spire, low nodular sculpture and a closed umbilicus as in *Guildfordia*, although there is no basal depression, and a marginal row of nodules protrudes down from the edge of the base below the peripheral keel. Protrusion of the nodules from the base seems to be foreshadowed in *Guildfordia* by the cessation of the nodular sculpture above the peripheral row of spines, and we regard *Opella* as a subgenus of *Guildfordia*. *Fractopella* Beu, 1970, p. 123 (type species (original designation): *Fractopella megapex* Beu, 1970) seems best regarded as another subgenus of *Guildfordia*, distinguished by its smooth, trochoid, bulbous protoconch, unlike the low, prominently carinate one of all other Turbininae.

Vitiastrea Ladd, 1966, p. 45 (type species (original designation): *Astraea (Vitiastrea) holmesi* Ladd, 1966, Upper Eocene, Tonga) known only from the unique holotype, is a minute (2.4 x 3.0 mm) round-whorled shell superficially resembling the much larger *Lunella* Röding, with two prominently nodular angulations around the last whorl. Only 1½ whorls of the teleoconch are developed, and it is a juvenile specimen that could belong in either *Turbo* (s.l.) or *Astraea* (s.l.). Clarification of its relationships must await the collection of adult material.

Bolma Risso, 1826. Species here placed in *Bolma* are similar in having a turbate shell; one or, in most species, two angulations on the last whorl (and one on spire whorls) that bear nodules or spines on most species; a simple columellar callus which, in mature shells of most species, spreads over much of the base adjacent to the columella, and is coloured yellow or orange in some species. The operculum is simple, markedly convex, and smooth or with a granular, in some species depressed, central area. The position of angulations on whorls, length of spines, and details of fine nodular ornament and opercular sculpture, features that have been used to define several genera or subgenera, seem to us to be specific characters within this group and we propose to place all species in the genus *Bolma*, recognising as a separate subgenus only *Senobolma* Okutani, 1964.

Two species groups can conveniently be recognised within *Bolma* s.s. One, the "*Bolma rugosa* group" is composed of species with generally rather solid, larger shells, usually with distinct, irregular axial folds dorsally and an oval, often coloured operculum. The other group, the "*Bolma guttata* group" is composed of species with generally smaller shells of lighter build and usually with a white, circular operculum and regular gemmate sculpture. Some species share some features of both groups and consequently the groups are not considered to be of subgeneric status. Species are classified in one or other of these two species groups in the taxonomic section below, and a list of all the Recent taxa of *Bolma* is presented at the end of this report.

Radulae

The radulae of the following species of *Bolma* have previously been figured: *B. rugosa* (Linné) Troschel and Thiele, 1879, p. 217, pl. 21, fig. 1; *B. henica* (Watson) Thiele, 1903, p. 121, 163, pl. 8, fig. 45; *B. recens* (Dell) Dell, 1967, p. 306, fig. 8; *B. guttata millegranosa* (Kuroda and Habe) Habe, 1958, p. 45, pl. 3, fig. 1; *B. modesta* (Reeve) Habe, 1958, p. 46, pl. 3, fig. 13; *B. tayloriana* (Smith) Barnard, 1963, p. 217, text-fig. 5d.

Habe (1958) separated *Hirasazaea*, *Galeoastrea* and *Bolma* on minor shell characters, and also figured the radulae of *Galeoastrea* (*Galeoastrea*) *millegranosa* and *G. (Hirasazaea) modesta*. The radulae are not clearly drawn and show a peculiar peg-like "cusp" on the central tooth which was referred to by Dell (1967, p. 307).

This peg-like "cusp" is apparently present on the central teeth of all of the examined species of *Bolma*. It is a flat peg on the ventral (inside) surface of the tooth and is attached to the radular membrane. It has been misinterpreted as a true cusp by some authors and is usually shown in illustrations as appearing on the upper face of the tooth. Apparently the central teeth are so transparent that the peg shows through clearly. Depending on the length of the peg and the angle of the tooth it has been shown to extend beyond the cutting edge of the central tooth or as lying well within it. Such a comparison can be made between Troschel and Thiele's (1879) figure of the central tooth of *Bolma rugosa* and of Barnard's (1963) figures of the central tooth of "*Astraea*" *tayloriana*. A similar peg or basal plate occurs in most other genera of Turbinidae and presumably has a supportive function.

Because of the difficulty in comparing the published illustrations of turbinid radulae, an examination of the radulae of species belonging to several genera of the Turbinidae was undertaken to provide a basis for comparison with those of *Bolma* species (figs 15-19).

For the purposes of the following discussion only the generic names will be used. Full details of the species names and their data can be found in the captions to the figures referred to.

The radula of the type species of *Astralium* has very distinctive central teeth (figs 15e, f), and the lateral teeth of this and other species of the genus show a highly advanced type of articulation (figs 15a, b). The radulae of the type species of *Bellastraea*, *Astralium*, and *Micrastraea* (here considered to be synonyms) are virtually identical (figs 15b-f). This type of central tooth is in marked contrast to those seen in the other genera examined where any articulation of the lateral teeth was not associated with any significant change in the shape of the teeth.

The radulae of species of *Astraea*, *Bolma*, *Bolma* (*Senobolma*), and *Guildfordia* all show a general similarity, with roughly oval or pentagonal central teeth, each having a short peg which hardly projects, or does not project, above the slightly curved or straight, simple cutting edge when the tooth is horizontal. The peg is flat, short, blunt, broad, and usually expanded distally (figs 16k, 17f, 18c, g, i, k).

There is some variation in the central teeth of the few species of *Bolma* examined to date. Some species in the "*Bolma rugosa* group," as here recognised, have central teeth with a pair of short latero-basal projections on each tooth (figs 18b, d, e, h, k) and tend to have a stronger, more recurved cutting edge than species in the "*Bolma guttata* group" (figs 19a, d, f). In other characteristics they closely resemble one another and some (figs 19d, e) are somewhat intermediate in shape. The central teeth of *Guildfordia* (fig. 17h) and *Bolma* (*Senobolma*) (fig. 17j) agree well with those of the "*Bolma guttata* group" and

those of *Astraea* (figs 16j-l) agree well with those of the "*Bolma rugosa* group", although we do not consider that all these similarities necessarily indicate close phylogenetic relationship.

The median and outer marginal teeth of the *Bolma-Astraea* group are relatively simple and appear to be of little value at the generic level. They are sometimes rather heavily serrated as in some species of *Bolma*, such as *B. rugosa* (fig. 18a) and *B. jacquelineae* (fig. 18f), *Bolma* (*Senobolma*) (fig. 17i) and *Guildfordia* (fig. 17g).

The radulae of species of *Turbo*, involving several subgenera (figs 16a-c; 17a-e), and that of *Cookia* (figs 16f-i), show a close similarity and differ from those of other Turbinidae examined. The central tooth is pentagonal to almost triangular in shape with a long, very thick peg which consists of 2 layers, the upper layer being shorter than the lower (figs 16a; 17c-e). The inner marginal teeth, with the exception of the innermost pair of marginals in each row, have a peculiar cusp pattern (figs 16a, f, 17a) quite unlike the simple cusps seen in all the other groups examined, with the exception of *Lithopoma*. The main difference between the central teeth of *Cookia* and those of *Turbo* is that the depression on the outer face of each tooth which indicates the point of attachment of the peg is placed high up in *Cookia* (fig. 16i) but is often near the base of the tooth in *Turbo* species (fig. 16l; 17e), although at least two *Turbo* species (placed in different subgenera) show an intermediate condition (fig. 17a, b).

Lithopoma has a central tooth that is much more elongate than those of any of the other genera examined and the short cutting edge is strongly recurved to form a powerful, square cusp (fig. 16d). The marginal teeth (fig. 16e) are like those of *Turbo*, and its relationships, and those of *Cookia*, are probably with that group rather than with *Astraea* under which they were placed by Knight *et al.* (1960) as subgenera.

In summary, the morphology of the radula, and in particular of the central teeth, shows that three fairly distinct groups can be recognised. The genus-group taxa having similar radulae to those of *Bolma* species are *Astraea*, *Guildfordia* and *Senobolma*. Both *Astraea* and *Guildfordia* are easily differentiated from *Bolma* on shell characters, and *Senobolma* is here regarded as a subgenus of *Bolma*. The *Turbo* group includes *Cookia* and *Lithopoma*, and *Astralium* forms the third and most distinctive group.

Fossil *Bolma*

The earliest record of *Bolma* is a 5 mm-high, fragmentary external mould in Teurian (Paleocene) cemented siliceous sandstone (Kauru Formation) from GS3773, Raupo Creek, near Five Forks, inland from Oamaru, New Zealand. Apart from this specimen, the genus is first known in Upper Eocene rocks of New Zealand, Australia and Tonga. Paleocene and Eocene species are all small, rather low spired, with channelled sutures and granulate or scaly sculpture. They closely resemble some living species, particularly *B. guttata* (Adams) and *B. recens* (Dell). The Miocene species *B. granifer* (Martin) from Java also falls into this group. The genus probably migrated into the Tethyan region from the Indian Ocean in the early Oligocene as the first Tethyan record is from the upper Oligocene. The genus also reached the Atlantic in the Miocene and evolved into several species, thus enabling a Pliocene recolonization of the Mediterranean following the dessication of that sea in the late Miocene. The Atlantic fauna is now reduced to only 3 species, one of which, *B. rugosa* (Linné), is the sole surviving member of the genus in the Mediterranean. It is possible that some species of *Bolma* may have re-entered the Indian Ocean around South Africa but there is no fossil evidence to support this view. Strangely, for a genus with several Tethyan Atlantic species, there are no fossil or living records of *Bolma* from the Americas.

This review is concerned primarily with the world Recent species of *Bolma*, and with the fossil species of Australia and New Zealand. We have made no attempt to list in their entirety the very numerous species of *Bolma* recorded in the voluminous literature on European Tertiary Mollusca. We list here fossil species from non-European localities that we include in *Bolma*. Original assignments follow the species names and references are given to species not diagnosed elsewhere in the paper. This is followed by a brief summary of the major works in which European Tertiary species are described.

Non-European fossil *Bolma*:

anacanthos n. sp., Oligocene, Victoria.

amabilis, *Turbo* (*Modelia*), Ozaki, 1954, Pliocene, Japan (synonym of *B. guttata guttata* A. Adams).

austroconica n. sp., Oligocene, Victoria.

?*brasiliensis*, *Astraea*, Ferriera and da Cunha, 1957, p. 14, pl. 2, fig. 3, 4, Miocene of Para, Brazil (may belong in *Bolma* but resembles more a distorted mould of *Turbo*).

crassigranosa, *Gibbula*, T. Woods, 1877, Lower Miocene, Tasmania.

flindersi, *Astralium* (*Calcar*), T. Woods, 1877, Lower Miocene, Tasmania.

flindersi darraghi n. subsp., Eocene, Victoria.

girgylla, *Astralium* (Reeve), Altena, 1939, p. 46, fig. 1a, b, c — Pliocene of Cheribon, Java, and Pleistocene, New Hebrides.

granifer, *Turbo* (*Callopoma*), Martin, 1883, p. 184, pl. 9, fig. 178, Upper Miocene of Java; figured by Pannekoek, 1936, p. 60, pl. 3, fig. 40.

hataii, *Bolma*, McNeil, 1960, p. 34, pl. 7, fig. 5, 9, 14, Miocene or Pliocene Shinzato Tuff, Okinawa (see under *B. modesta* below).

kendengensis, *Astralium* (*Bolma*), Altena, 1938, p. 291, fig. 14a-c, 15a, b, Pliocene, Java (similar to *B. guttata guttata* (A. Adams)).

marshalli, *Turbo*, Thomson, 1908, Upper Eocene and Oligocene, New Zealand.

ornatissimum, *Astralium* (*Calcar*), T. Woods, 1877 (synonym of *B. crassigranosa* (T. Woods)).

pseudomodesta, *Astraea*, Nomura, 1935, p. 208, pl. 10, fig. 1a-c, Pliocene Byoritzu beds of Taiwan (see under *B. modesta* below).

cf. *pseudomodesta*, *Bolma*, McNeil, 1960, p. 33, pl. 16, fig. 10, 23, Pliocene Naha Limestone of Okinawa.

stearnsi, *Astraea* (*Bolma*), Ladd, 1970, C4, pl. 3, fig. 6, 7, Upper Eocene, Eua Is., Tonga (possibly related to *B. tamikoana* (Shikama)).

takitai, *Pachypoma*, Ozaki, 1954, p. 12, text-fig. 1, 2, Pliocene, Japan.

virgata, *Astraea*, Ozaki, 1954, p. 12, pl. 6, fig. 1-6, Pliocene, Japan (similar to *B. guttata millegranosa* (Kuroda and Habe)).

n. sp. ?, *Bolma*, McNeil, 1960, p. 34, pl. 2, fig. 7, Miocene Yonobaru Clay, Okinawa (see under *B. modesta* below).

sp. ind., *Bolma*, McNeil, 1960, p. 33, pl. 7, fig. 15, Miocene or Pliocene Shinzato Tuff, Okinawa (see under *B. modesta* below).

European fossil *Bolma*:

In his revision of Italian Miocene and Pliocene species of *Bolma*, Sacco (1896, pp. 9-19) included seven species in *Bolma* (*sensu stricto*): *B. rugosa* Linné with 10 varieties; *B. meynardi* (Michelotti, 1847); *B. taurinensis* Sacco, 1896, with two varieties; *B. granosa* (Borson, 1821) with one variety; *B. muricata* (Dujardin, 1835) with three varieties; *B. borsoni* (Michelotti, 1847) with three varieties; and *B. proborsoni* Sacco, 1896, with one variety. In addition, he included the following six species in *Ormastraliium* Sacco and related groups: *Bolma* (*Oobolma*) *castrocarensis* (Foresti, 1876) with one variety; *Ormastraliium fimbriatum* (Borson, 1821) with 13 varieties; *O. subspinosum* Rovereto in Sacco, 1896, with one variety; *O. (Tylastraliium) speciosum* (Michelotti, 1847) with one variety; *O. (T.) taurospeciosum* Sacco, 1896 (a total of 13 species and 43 varieties, not including typical varieties). He compared *Ormastraliium carinatum* (Borson) var. *prohenica* Sacco, 1896 closely with "*Ormastraliium*" *henicum* (Watson), indicating that he thought Italian Pliocene and Indo-Pacific Recent species are congeneric, as we conclude here.

Cossmann (1918, pp. 152-6) synonymised *Oobolma* Sacco with *Bolma* Risso, and included 13 Miocene species and three Pliocene species and four varieties in *Bolma*. He synonymised *Tylastraliium* Sacco with *Ormastraliium* Sacco, ranked *Ormastraliium* as a subgenus of *Bolma*, and included in *Bolma* (*Ormastraliium*) five Miocene species and the Pliocene species previously included by Sacco (1896). Most of the Miocene species placed in *Bolma* and *Ormastraliium* by Cossmann (1918) had previously been fully documented by Cossmann and Peyrot (1918, pls. 5, 6). More recently a further European fossil, *Bolma belgica*, was included in the genus by Glibert (1952, p. 14, pl. 1, fig. 8) and the Aquitaine relatives were revised and some new species named by Magne and Vergneau-Saubade (1971). Most recently, Baluk (1975, p. 43-6, pl. 6) provided good figures of three species of *Bolma* from the Upper Miocene Korytnica Clay of Poland.

Systematic Descriptions

Genus *Bolma* Risso, 1826

Bolma Risso, 1826, p. 117. Type species (monotypy): *Bolma rugosa* Risso (= *Turbo rugosus* Linné, 1767), Miocene to Recent, Europe — Mediterranean.

Oobolma Sacco, 1896, p. 14. Type species (monotypy): *Turbo rugosus* var. *castrocarensis* Foresti, 1876, Pliocene, Italy.

Ormastraliium Sacco, 1896, p. 15. Type species (original designation): *Trochus fimbriatus* Borson, 1821, Pliocene, Italy.

Tylastraliium Sacco, 1896, p. 19. Type species (subsequent designation, Sacco in Cossmann, 1918: 155): "*Turbo michelotti*" Cossmann, 1918 (err. pro *Turbo speciosa* Michelotti, 1847), Pliocene, Italy.

Pseudastraliium Schepman, 1908, p. 27. Type species (monotypy): *Astraliium* (*Pseudastraliium*) *abyssorum* Schepman, 1908, Recent, Indonesia.

Incilaster Finlay, 1926, p. 367. Type species (original designation): *Turbo marshalli* Thomson, 1908, Oligocene and late Eocene, New Zealand.

Galeoastraea Habe, 1958, p. 45. Type species (original designation): *Galeoastraea millegranosa* Kuroda & Habe (*nomen nudum*, = *Galeoastraea millegranosa* Kuroda & Habe in Habe, 1958).

Hirasazaea Habe, 1958, p. 46. Type species (original designation): *Trochus modestus* Reeve, 1842, Recent, Japan.

Barnard (1963, p. 217) noted that Watson (1886, p. 131) commented that Risso had spelled the generic name *Bolina*, which is twice pre-occupied. However, reference to Risso (1826, p. 117) showed that the name was originally spelled *Bolma*.

A KEY TO THE RECENT SPECIES OF *BOLMA* (*BOLMA*)
BASED ON THE ADULT SHELL AND OPERCULAR CHARACTERS

1. Shell with axial folds on shoulder 2
 Shell without axial folds on shoulder 7
2. Shell with peripheral and basal angles equal to subequal in strength (and in development of spines if present) 3
 Shell with peripheral and basal angles unequal in strength and spine development 6
3. Shell large (40-60 mm in height) with broad basal callus 4
 Shell small (20-40 mm in height) with narrow basal callus 5
4. Colour of shell greenish, operculum orange *rugosa* (Linné).
 Colour of shell pink, operculum white *modesta* (Reeve).
5. Shell with coarsely beaded sculpture, peripheral and basal angles about equal in strength *jacquelineae* (Marche-Marchad).
 Shell with fine sculpture, basal angle slightly stronger than peripheral angle *andersoni* (Smith).
6. Shell with wide basal callus occupying about $\frac{2}{3}$ of base *johnstoni* (Odhner).
 Shell with narrow basal callus occupying about $\frac{1}{4}$ of base *aureola* (Hedley).
7. Shell with peripheral angulation of penultimate whorl not separated from shoulder of body whorl 8
 Shell with peripheral angulation of penultimate whorl separated from shoulder of body whorl 13
8. Shell large (greater than 38 mm in height) *tayloriana* (Smith)
 Shell small to medium (less than 35 mm in height) 9
9. Shell with spinose or subspinose peripheral angle, basal angle weak to strong 10
 Shell lacking distinct peripheral or basal angles, sculpture undifferentiated *midwayensis* (Habe & Kosuge).
10. Shell with very short spines on peripheral angle, height of spire usually greater than maximum width of shell, no trace of sutural channel, basal callus pale yellow *somaliensis* nov.
 Shell with very short to long spines on peripheral angle, height of spire usually less than, or about equal to, maximum width of shell, basal callus white ... 11

11. Shell with long spines (about equal to width of shoulder) on peripheral angle *persica* (Dall).
 Shell with short spines (equal to $\frac{1}{2}$ width of shoulder or less), or none, on peripheral angle 12
12. Shell with orange or yellow basal callus, no sutural channel *tamikoana* (Shikama).
 Shell with white basal callus, with narrow to moderate sutural channel *guttata* (Adams).
13. Shell with 1-3 spiral rows of gemmules or scales between peripheral and basal angles 14
 Shell with 4 or more rows of gemmules or scales between peripheral and basal angles 17
14. Shell with wide sutural channel bordered below by a row of nodules much stronger than those on remainder of shoulder *henica* (Watson).
 Shell with moderate to very narrow sutural channel bordered below by a row of gemmules only slightly stronger than those on remainder of shoulder 15
15. Shell with long spines (about equal to width of shoulder) *persica* (Dall).
 Shell with short spines (equal to $\frac{1}{2}$ width of shoulder or less) or spines absent 16
16. Shell with basal and peripheral rows of spines subequal and visible on spire whorls *girgyllus* (Reeve).
 Shell with peripheral rows of spines and basal row of gemmules or scales, peripheral row only visible on spire whorl *guttata* (Adams).
17. Shell with distinct peripheral and basal angles, more than 10 spines on body whorl 18
 Shell with distinct peripheral angle and weak basal angle, less than 8 spines on body whorl *kermadecensis* nov.
18. Shell with 4-5 spirals between basal and peripheral angles, spines moderate to long *henica* (Watson).
 Shell with more than 10 spirals between basal and peripheral angles, spines short to rudimentary 19
19. Base with axial rugae, shell fawn *recens* (Dell).
 Base mostly smooth, with no axial rugae, shell pink and white *bartschi* Dall.

Subgenus *Bolma* (sensu stricto)

A. *Bolma* rugosa group

***Bolma andersoni* (Smith, 1902)**

Fig. 1j-n

Astralium (*Bolma*) *andersoni* E. A. Smith, 1902: 248, pl. 4, fig. 7.

Astralium (?*Bolma*) *andersoni*. — G. B. Sowerby 3rd, 1903: 230, pl. 5, fig. 5.

Astraea andersoni. — Barnard, 1963: 219.

DIAGNOSIS. Shell: height about equal to diameter, base almost flat, whorls strongly angled but concave between angulations. Peripheral angulation margining base, bearing 12 large, rounded, hollow, scale-like spines per whorl; upper angulation at half whorl height, bearing 9 to 14 large nodules, expanded laterally into prominent spines on juvenile shell but reduced to rounded, scale-tipped nodules on last few whorls of sub-adult specimen. A weak basal angulation represented by weakly gemmate spiral cord near margin of base of juvenile shell, and by weakly defined cord and marked colour change in sub-adult. Upper surface of whorls sculptured with low, narrow-crested axial folds extending from upper suture to each nodule of upper angulation, and entire surface densely covered with fine, wavy spiral lirae, more prominent on nodules than elsewhere; one cord between upper and peripheral angulations slightly more prominent than other spiral lirae. Base bearing narrow, smooth callus in central fifth of radius, remainder sculptured with about 10 low, narrow, finely scaled spiral cords and many fine interstitial lirae. Nodule rows and lower half of whorls bright purplish pink, shading to a more yellow tinge on upper half of whorls and to pinkish yellow on base; basal callus pale yellow.

Operculum: Not seen.

DIMENSIONS. Holotype: height 27 mm, diameter 31 mm (Smith, 1902); figured subadult: height 31.6 mm, diameter 34.3 mm; figured juvenile: height 12.1 mm, diameter 14.0 mm. Maximum size recorded 85 mm in height (Barnard, 1963, p. 220).

TYPE LOCALITY. Off Durban, South Africa, ex stomach of fish.

HOLOTYPE. Smith (1902, p. 249) stated that the holotype was in the collection of "Mr. Anderson, junr., of Durban." Its present location is unknown.

MATERIAL EXAMINED. Off Natal (NM, 3729) (figured sub-adult); off Durban, ex gut loggerhead turtle, 1973 (NM, A235) (2 juveniles).

OTHER LOCALITIES. South Africa; 32°45'S, 28°26'E, near Cape Morgan, 66 m; off Port Shepstone, 44 m; off Itongazi River, 46 m (all from Barnard 1963, p. 220).

Bolma andersoni is similar in shape, type of sculpture, and coloration to *B. jacquelineae* (Marche-Marchad), *B. modesta* (Reeve) and *B. girgylla* (Reeve), but differs from all related species in its flatter and more finely sculptured base, in its single row of relatively large, rounded nodules above the peripheral row, and in its very reduced basal angulation. The larger of the two juvenile specimens available bears long spines on the nodules of the upper angulation (fig. 1j-k), but these have been broken off the sub-adult specimen examined. Barnard (1963, p. 220) assigned shells up to 85 mm high to *B. andersoni*. The unidentified juvenile specimen figured by Barnard (1963, fig. 7 f, g,) is similar to available juveniles of *B. andersoni*, and probably belongs in this species; it is from off Unkomaas, Natal, in 73 m (SAM, A9236).

***Bolma aureola* (Hedley, 1907)**
Figs 1a-c, 18h, i

Astralium (*Cookia*) *aureolum* Hedley, 1907: 491, pl. 21, figs 56-58.

Cookia aureolum. — Rippingale & McMichael, 1966: 37, pl. 2, fig. 16; Habe & Kosuge, 1966: 13, pl. 4, fig. 8.

DIAGNOSIS. Shell: Whorls convex, with scaly, nodular sculpture and medium to short peripheral spines. Peripheral angulation spinose, sharp in early spire whorls, at lower

$\frac{1}{3}$ - $\frac{1}{4}$, becomes rounded on later whorls, weak and rounded in large shells. About 10-15 short spines on last whorl of medium sized shells; up to 22 in large shells (such as the holotype). Spines relatively long in juveniles. A second angle just below periphery also becomes rounded on large shells. Eight-nine squamose spiral ribs on base and 10 on side of penultimate whorl; lower spirals on sides of whorls very oblique and pass laterally on to the peripheral spines. One spiral between peripheral and basal angles, the latter having an additional spiral cord. Basal callus narrow, covering about a quarter of base, bright orange; columella white. Surface purplish-red, brick-red or dull orange, often with a white and pale olive marbled band in the centre of the upper surface of the whorls of immature shells.

Operculum: Oval, with large marginal rib and central spiral depression as in *B. rugosa*, but more elongate than that species. Very similar to that of *Lithopoma (Cookia) sulcata*, which, however, is white, not pinkish-orange as in *aureola*.

DIMENSIONS. Largest shell seen (C. 37246): height 88 mm, diameter 98 mm. Holotype: height 87 mm, diameter 92 mm.

TYPE LOCALITY. S. of Masthead Island, Capricorn Group, Queensland, 37 m.

HOLOTYPE. AM, C. 18807.

OTHER MATERIAL EXAMINED. (all AM; numbers in brackets show number of specimens). *Queensland*: Gillett Cay, Swain Reefs, 69 m, C. 72698 (1); Northwest Is., Capricorn Group, C. 72695 (1); Heron Is., C. 72693 (1); 27 km E. of Heron Is., 55 m, C. 72690 (1); Masthead Reef, C. 37246 (1); off Bundaberg, C. 72697 (2); off Burnett Heads, C. 72694 (4); prawn trawl south of Fraser Is., C. 72693 (3); Tin Can Bay, C. 62499 (3); Off Wide Bay, 46 m, C. 72692 (2), 55 m, C. 72703 (1); trawled in Wide Bay, C. 81962 (2); Off Jumpin Pin Bar, near Southport, 31 m, C. 63161 (2); off Southport, C. 72689 (1); *New South Wales*: off Tweed Heads, northern N.S.W., 55 m, C. 72691 (3).

Small and medium-sized shells are similar to *B. modesta* (Reeve), from which they differ in their brighter colour, longer spines, narrower callus pad, and more strongly sculptured operculum. Still more alike is *B. johnstoni* (Odhner), which has closely similar spination, but has a widely spread basal callus and a convex, centrally granular operculum.

***Bolma girgylla* (Reeve, 1843)**

Fig. 2a-c

Trochus girgyllus Reeve, 1843: 185; Reeve, 1848, *Trochus*, pl. 10, fig. 53.

Turbo (Bolma) gyrillus (sic). — G. B. Sowerby 3rd, 1886: 208, pl. 499, fig. 73.

Astraea (Bolma) modesta girgyllus. — Hirase, 1938: 41, pl. 74, fig. 8.

Astralium girgyllus. — Altena, 1939: 46, pl. 3, fig. 1a-c.

Astraea modesta girgyllus. — Yen, 1942: 182, pl. 12, fig. 24 (type figured).

Astraea girgyllus. — Kuroda & Habe, 1952: 39.

Galeoastraea (Hirasazea) girgyllus. — Habe, 1958: 55; Okutani, 1972: 79, pl. 1, fig. 3, 4.

Bolma girgyllus. — Oyama & Takemura, 1960: *Bolma*, fig. 5, 6.

DIAGNOSIS. Shell: Whorls rounded, sculpture nodulose. Peripheral angle at middle of whorls on spire and body whorl, with 2 rows of long spines; spines on uppermost row sometimes very long and heavy, about 11-14 on body whorl. Subsutural zone lightly convex, with 2 rows of gemmules slightly stronger than the 7 rows on the remainder of convex shoulder. Peripheral angulation and zone between it and prominent basal angulation with about 3 irregular rows of gemmules equal in size to those on shoulder and outer base. Base with 10-12 rows of beaded spines, enlarging towards the umbilical area. Basal callus narrow, orange, columella white. Outer lip expanded when mature. Colour pinkish fawn, sometimes with dark purplish dorsal surface, or a series of dark purple spots on the upper shoulder (description mainly based on specimen from Moluccas, Indonesia).

Operculum: White, with convex surface, central area with a slight depression.

DIMENSIONS. Lectotype (here chosen): height 57.4 mm, diameter 57.2 mm. Zenusu Bank, Japan: height 42.9 mm, diameter 41.6 mm.

TYPE LOCALITY. "China."

TYPES. Lectotype (1968673/1) and paralectotype (1968673/2) in BMNH. The lectotype, chosen here, is the specimen figured by Yen (1942).

OTHER MATERIAL EXAMINED. "Mollukken, Indonesie," coll. Schepman, 1 spec. (Zoologisch Museum, Amsterdam; not the "Siboga" specimen recorded as *Astralium girgyllus* by Schepman (1908), which is *B. tamikoana* (Shikama)); Zenusu Bank, S. of Izu Peninsula, Japan, 34°00.1'N, 138°51.0'E, 90 m (Tokai Regional Fisheries Lab.) (1), recorded by Okutani (1972, p. 79); Stn 438A, Upper Kere River, 166°56'74"E, 15°34'S, Espirito Santo, New Hebrides, Pleistocene (U.S. Geological Survey, Washington, D.C.) (1).

OTHER LOCALITIES. Tosa Bay, Shikoku, Japan (Oyama & Takemura, 1960); rare on rocky bottom in 50-100 m, from Kochi Pref., Japan, and the China Sea (Habe, 1964).

FOSSILS. Recorded fossil from the Pliocene of Cheribon, Java (Altena, 1939), but the identification was questioned by McNeil (1960, p. 34). We have not seen the specimen but the figures given by Altena (pl. 3, fig. 1a-c) closely resemble *B. girgylla*.

Bolma girgylla superficially resembles *B. modesta* (Reeve) but differs in the minor spiral sculpture consisting of rounded gemmae rather than scales, in there being consistently two rows of longer spines on the last whorl, in lacking any axial folds on the shoulder and in the narrower basal callus.

This species shows intermediate characters between the *B. rugosa* and *B. guttata* groups but is placed here because of its large size and because it has been frequently associated with *B. modesta*.

***Bolma jacquelineae* (Marche-Marchad, 1957)**

Figs 2f-j; 18e-g

Astraea (Bolma) jacquelineae Marche-Marchad, 1957: 200, pl. 1, figs 1, 2...

DIAGNOSIS. Shell: Whorls prominently and equally bi-angled, strongly sculptured. Peripheral angulation and basal angulation equal in strength, separated by a concave area. Spines and spiral cords rather weakly developed; 15 low, rounded nodules on each angulation on last whorl, and 6 weak, gemmate cords on sides of whorls. Basal callus narrow. Surface red tinged with violet, early whorls white.

Operculum: Nearly circular, with central depression and outer concentric ridge as in *B. rugosa*; surface pustulose; wine-red with white edges.

DIMENSIONS. Holotype: height 31 mm, diameter 30 mm; figured specimen: height 20.9 mm, diameter 22.8 mm; largest specimen seen: height 37 mm, diameter 33 mm.

TYPE LOCALITY. 32 km W. of Freetown, Sierra Leone, 25 m.

HOLOTYPE. In Muséum National d'Histoire Naturelle, Paris.

MATERIAL EXAMINED. Off Tema, Ghana, W. Africa (NMW; AM; DMNH) (several).

OTHER LOCALITIES. Île du Prince, Guinea-Bissau (Portuguese West Africa), 75 m (Marche-Marchad, 1957). Tomlin & Shackelford (1915, p. 267) recorded *B. rugosa* from the island of São Thomé in the Gulf of Guinea. Mr. Peter Dance (*in litt.*) informed us that this specimen (Fig. 2j), now in NMW is *B. jacquelineae*.

Marche-Marchad (1957, p. 201) compared the shell closely with *B. johnstoni* (Odhner), noting that *B. jacquelineae* "differs by its much straighter and shorter spines, its finer and more regular spiral sculpture" (free translation). It is also smaller and taller spired than *B. johnstoni*.

***Bolma johnstoni* (Odhner, 1923)**

Fig. 2k-n

Astraea (Bolma) johnstoni Odhner, 1923: 9, pl. 1, figs. 15-17.

Astraea johnstoni. — Nicklès, 1950: 45, text-fig. 31.

Astraea (Astraliium) johnstoni. — Anon., 1972: 13, 3 figures.

DIAGNOSIS. Shell: Whorls convex, with scaly, nodular sculpture and moderately long peripheral spines. Peripheral angulation on lower 1/3 of spire whorls, somewhat rounded on last whorl. Twelve spines on body whorl. A second angle below periphery is rather indistinct on body whorl. Five coarsely squamose, oblique cords below, the lowest at the basal angulation. Five sparsely nodulose basal cords. Basal callus broad, extending over much of base, reddish brown, columella white. Surface light red.

Operculum: Quadrately oval, smooth and convex with granular central area; reddish-brown with white margins.

DIMENSIONS. Not known.

TYPE LOCALITY. Porto Alexander, Angola, 60 fathoms (110 m).

HOLOTYPE. Natural History Museum, Stockholm.

OTHER LOCALITIES. Apart from the three specimens from the type locality, the only recorded specimens are two from off Orstom, Gulf of Guinea, in 85 m (Anon. 1972, p. 13).

Odhner (1923, p. 10) compared this species only with *B. rugosa*, but it is more similar to *B. modesta* and *B. aureola* than to *B. rugosa*. It differs from *B. modesta* in the more regularly squamose upper surface, in developing a single peripheral row (rather than two or three rows) of spines, and in the reddish brown (rather than white) operculum; and from *B. aureola* in its markedly smaller size (assuming Odhner's figure is natural size; he did not publish dimensions), the more widely spread basal callus, the lack of a spiral groove in the operculum and the markedly fewer rows of granules; and from both in its reddish-brown, rather than orange, basal callus.

***Bolma modesta* (Reeve, 1842)**

Figs 1d-f; 2d, e; 18c, d

Trochus modestus Reeve, 1842: 165, pl. 218, fig. 14; Reeve, 1843: 185; Reeve, 1848: 139, pl. 13, fig. 67; Reeve, 1861: *Trochus*, pl. 10, fig. 56.

Turbo (Bolma) modestus. — G. B. Sowerby 3rd, 1886: 208, pl. 505, fig. 150.

Bolma modesta. — Kuroda, 1941: 77; Kira, 1955: 20, pl. 10, fig. 5; Oyama & Takemura, 1960: *Bolma*, fig. 3, 4.

Astraea modesta. — Yen, 1942: 182; Kuroda & Habe, 1952: 39.

Astraea (Bolma) modesta. — Nomura & Zinbo, 1934: 146, pl. 5, fig. 37; Hirase, 1938: 41, pl. 74, fig. 6.

Galeoastraea (Hirasazaea) modesta. — Habe, 1958: 55, pl. 3, fig. 13; Kira, 1961: 20, pl. 10, fig. 5; Kira, 1962: 18, pl. 11, fig. 5; Kuroda *et al.*, 1971: 49, pl. 14, fig. 2; Okutani, 1972: 79.

DIAGNOSIS. Shell: Whorls rounded, sculpture mostly scaly. Peripheral angle at middle of whorls on spire, with 1-2 (3 in a few specimens) rows of short to relatively long spines on the rounded body whorl. Sculpture very variable. Subsutural zone concave, sometimes bearing strongly prosocline, high, thin growth lamellae. Upper surface of whorls bearing 4-8 rows of hollow scales, and in some specimens short, low, rounded axial folds below suture. Peripheral angulation and zone between it and weak basal angulation bears row of small to large, hollow, scale-like spines, and on most specimens a further row of spines forms weak third angulation between other angulations. Up to 3 secondary rows of spines present, and 2-6 peripheral rows of minute scales. Base with 8-9 spiral rows of low, hollow scales. Basal callus broad, bright orange-yellow; columella white. Outer lip expanded when mature. Surface pinkish mauve, with a nacreous gleam.

Operculum: Slightly oval, with a prominent marginal ridge; central area almost flat, surface irregularly and minutely granular; white.

DIMENSIONS. Figured specimens: height 50 mm, diameter 56 mm; height 45.7 mm, diameter 49 mm.

TYPE LOCALITY: Japan.

TYPES: Reeve's (1842) figured specimen was not found in the BMNH, but the specimen in fig. 2d-e was identified as this species by Reeve (BMNH, 19782).

OTHER MATERIAL EXAMINED. Japan: Honshu (AM) (1); off Kii, Honshu, 90 m (AMNH) (3), (USNM) (2), (AM) (2); Nagasaki, Kyushu (ANSP) (2), (USNM) (2) (S. Australian Museum) (2); Boshu (USNM) (4); Hizen, Kyushu (AMNH) (2); Sagami Bay (ANSP) (3), 18-37 m (AMNH) (3); Tosa Bay, Shikoku (ANSP) (5); off Honshu Is., U.S. Fisheries Commission Stn 3727, 62 m and Stn 3734, 66-88 m (USNM) (3 and 2); Miara (USNM) (1); Mikawa (USNM) (2); Hashimoto (USNM) (1); off Hondo, S. coast, U.S. Fisheries Bureau Stn 3703, 57 m (USNM) (1); off Pratas Is., China Sea, 274 m, U.S. Bureau of Fisheries (USNM) (1); Loo Choo Ids (= Ryukyu Ids) (ANSP) (31); Iagashima Is., 91-146 m (Bishop Museum, Honolulu) (7).

OTHER LOCALITIES. Off Cape Ashizuri, Kochi Peninsula (Oyama & Takemura, 1960); "South of central Japan at 10-20 fathoms (= 18-36 m) deep" (Kira, 1962, p. 18); seven localities in Sagami Bay, and "Honshu (Boso Peninsula as northern limit), Shikoku, Kyushu, Formosa and China. On rocks and gravels of 20-100 m deep" (Kuroda *et al.*, 1971, p. 49).

Recorded as a fossil from the Pliocene Ryukyu Limestone of Kikaizima, Ryukyu Islands, by Nomura & Zinbo (1934, p. 146, pl. 5, fig. 37).

Several Miocene and Pliocene fossil species from Taiwan and Okinawa appear to fall within the variation of Recent *Bolma modesta* to judge from figures given by McNeil (1960): *Astraea pseudomodesta* Nomura, 1935, p. 208, pl. 10, figs. 1a-c; *Bolma* cf. *pseudomodesta* McNeil, 1960, p. 33, pl. 16, figs. 10, 23; *Bolma* sp. ind. McNeil, 1960, p. 33, pl. 7, fig. 15; *Bolma hataii* McNeil, 1960, p. 34, pl. 7, figs 5, 9, 14; *Bolma* n. sp.? McNeil, 1960, p. 34, pl. 1, fig. 7.

***Bolma rugosa* (Linné, 1767)**

Figs 1g-i; 18 a, b, j-l

Turbo rugosus Linné, 1767: 1234; Gmelin, 1791: 3592, sp. 14; Link, 1807: 132; Brocchi, 1814: 362; Borson, 1821: 90; Dillwyn, 1817, vol. 2, p. 829, sp. 33; Lamarck, 1822: 46; Deshayes, 1843: 197; Reeve, 1848: *Turbo*, pl. 6, sp. 25, fig. 26; Locard, 1892: 203, fig. 179; Nobre, 1931: 215, pl. 25, fig. 1.

Turbo calcar var. B. Gmelin, 1791: 3592.

Trochus rugosus. — Röding, 1798: 82; Philippi, 1836: 178; Philippi, 1844: 151.

Turbo armatus Dillwyn, 1817, vol. 2: 829, sp. 32 (immature).

Turbo (Bolma) rugosus. — Bucquoy, Dautzenburg & Dollfus, 1884: 332, pl. 38, figs 1-11 (very full synonymy and excellent figs); G. B. Sowerby 3rd, 1886: 208, p. 498, fig. 60.

Bolma rugosa. — Risso, 1826: 117; Troschel & Thiele, 1879: 217, pl. 21, fig. 9 (radula); Sacco, 1896: 9-11, pl. 1, figs 16-22 (with long synonymy and 10 varieties); Cossmann, 1918: 153, pl. 4, figs 24, 25.

Astraea (Bolma) rugosa var. *turboides* and *delphinoides* Coen, 1937: 145.

Astraea (Bolma) rugosa. — Nordsieck, 1968: 33, pl. 6, figs 17, 40.

DIAGNOSIS. Shell: Spire turbate, with strongly convex whorls and nodulose sculpture. Spire whorls angled in middle, last whorl with moderate basal angle at lower $\frac{1}{3}$. Upper angulation with medium to long spines on early spire whorls, extending to body whorl in some specimens. Spines on basal angulation of a few specimens. Sculpture of low spiral cords, crossing low, widely spaced nodules below the suture; subsutural nodules taper off towards periphery as low, rounded, slightly opisthocline radial ribs spaced their own width apart. Surface covered with high, thin, widely spaced, markedly prosocline, axial growth lamellae which are raised into hollow scales where they cross the spiral cords. 4-5 rather weak spirals on upper surface of penultimate whorl, 1 strong and usually 2 weak spirals between the peripheral and basal angulation and 4-5 spirals on base. Basal callus broad, covering up to half of base, brownish-orange; columella nacreous white. Outer lip slightly expanded when fully mature. Surface olive green, with white or orange patches on some specimens.

Operculum: Oval with thick, rounded, spiral marginal rib around a shallow central depression, its initial spiral hidden by a small swelling, smooth; bright brownish-orange, columellar edge and central swelling white.

DIMENSIONS. Figured specimen: height 47.5 mm, diameter 48 mm.

TYPE: Dance (1967: 22) stated that there is a specimen of *B. rugosa* in the Linnean Collection, housed by the Linnean Society of London, available for designation as a lectotype.

MATERIAL EXAMINED. Many specimens in several museums.

LOCALITIES. Recorded by many authors from a large number of localities from the Mediterranean Sea and the central eastern Atlantic south to the Canary Islands, to at least 200 m deep.

This species has been listed or figured in so many works since 1767 that we have not attempted to compile a complete synonymy. *Bolma rugosa* occurs commonly also in the Miocene, Pliocene and Quaternary of countries around the Mediterranean (see synonymy in Sacco, 1896). The variable sculpture has led to recognition of numerous varieties by both paleontologists (notably Sacco, 1896) and neontologists, and probably several southern European nominal species of fossil *Bolma* will be found to be part of the variation of *B. rugosa*.

B. *Bolma guttata* group.

***Bolma anacanthos* n. sp.**

Fig. 3j-l

DIAGNOSIS. Shell: Moderately large, with relatively low spire, sculptured with numerous spiral cords bearing granules or scales. Protoconch typical, of $2\frac{1}{2}$ whorls, teleoconch of $4\frac{1}{2}$ whorls. Peripheral angle at lower quarter of spire whorls, forming a sutural channel that becomes progressively shallower down the spire. Spire whorls flat above periphery, last whorl weakly convex with periphery at centre and a second weak angulation at upper third of height. Below periphery a weak basal angulation is defined by two slightly raised cords; all angulations become progressively weaker over last whorl so that last quarter is evenly rounded. Sculpture of approximately equally strong spiral cords over whole surface which, on upper part of whorls bear small, low, closely spaced, sharply rounded granules; on progressively lower cords the granules become progressively more scale-like. Subsutural spiral cord with rounded granules about twice size of others. About 20 spirals on last whorl and base, 5-7 on penultimate whorl above periphery. Base with a thin callus spread over about a third of its area, separated from columella by a groove.

Operculum: Unknown.

DIMENSIONS. Holotype: height 21.45 mm, diameter 20.76 mm.

TYPE LOCALITY. Jan Juc Formation, Zone 3 (Bird Rock ledge), Bird Rock Cliffs, Torquay, Victoria; F. A. Cudmore Colln.

HOLOTYPE. NMV, P. 31183.

OTHER MATERIAL EXAMINED. Bird Rock Cliffs, Torquay, G. B. Pritchard Colln, coll. J. T. Jutson, P.31186, NMV (2 paratypes).

AGE. Janjukian (Oligocene Australian local stage).

The new species is similar to *Bolma guttata millegranosa* (Kuroda & Habe) in general appearance, but differs in its smaller size, in having a weaker sutural channel, in lacking a marked basal angulation, in having a very much less marked peripheral angulation lacking spines, and in having a more closely sculptured base. It also closely resembles *B. tamikoana* (Shikama), from which it differs in its smaller size, in lacking all spines, in its wider basal callus, and in having a narrow sutural channel.

***Bolma austroconica* n. sp.**

Fig. 3a, b

DIAGNOSIS. Shell: Small, tall spired, with spiral rows of relatively coarse gemmae and a sharply angled periphery. Protoconch typical, of 3 whorls, teleoconch of $4\frac{1}{4}$ whorls. Whorls flat-sided, spire outline slightly convex for most of its height but strongly convex near apex. Suture simple. Periphery at basal angulation, i.e. at lower suture of spire whorls, sharply angled on last whorl. Sculpture of 4 spiral rows of rounded gemmae on penultimate whorl, the uppermost, third and fourth rows equally large, the second row weaker but becoming progressively stronger down the spire to be of equal strength to other rows on last half of last whorl. The third cord from upper suture bears short spines on first $2\frac{1}{2}$ teleoconch whorls, the spines becoming progressively stronger over first half-whorl and then progressively weaker, merely rounded gemmae over last $1\frac{1}{2}$ whorls. Fourth spiral forms basal angle of last whorl. Base flat, with 4 rows of gemmae smaller than those above periphery. Columella simple, no basal callus in material examined.

Operculum: Unknown.

DIMENSIONS. Holotype: height 15.45 mm, diameter 11.30 mm.

TYPE LOCALITY. Jan Juc Formation, "Spring Creek" = Bird Rock Cliffs, Torquay, Victoria.

HOLOTYPE. NMV P.31184, ex Mrs. M. Robertson Colln.

OTHER MATERIAL EXAMINED. Bird Rock Cliffs, Torquay, G. B. Pritchard Colln, P.31180, NMV (1 paratype); same locality, F. A. Cudmore Colln, coll. T. S. Hall, NMV (1 paratype); Jan Juc Formation, zone 4 (above Bird Rock ledge), Bird Rock Cliffs, Torquay, F. A. Cudmore Colln, P.31185, NMV (1 paratype).

AGE. Janjukian (Oligocene Australian local stage).

This new species is similar to *Bolma crassigranosa* (T. Woods) but differs in its flat-sided whorls, its more sharply angled periphery and its more equal rows of gemmae lacking marked spines. It is also similar to *B. flindersi* (T. Woods) but differs in its smaller size, taller and narrower form, its less numerous and more widely spaced spiral cords, and its lack of spines and sutural channel on the adult whorls.

***Bolma crassigranosa* (T. Woods, 1877)**

Fig. 3d-f

Gibbula crassigranosa T. Woods, 1877: 98; May, 1919: 70, pl. 8, fig. 4; Ludbrook, 1967: 66, pl. 2, fig. 18.

Astralium (Calcar) ornatissimum T. Woods, 1877: 98.

Astralium (Bellastraea) ornatissimum. — Ludbrook, 1967: 66, pl. 2, fig. 16.

DIAGNOSIS. Shell: Small, with tall to moderately tall spire, simple sutures, and convex whorls bearing spiral rows of large gemmae. Periphery weakly to strongly angled, prominent basal angle formed by protruding row of gemmae. Spire whorls with two major spiral cords, the upper bearing relatively large, axially elongated gemmae; the lower, at whorl centre, forms the peripheral angle and bears spines that are moderately

large to rudimentary in different individuals, and become progressively smaller down the last two teleoconch whorls. A weak third row of low gemmae lies immediately above the suture of spire whorls and forms the basal angulation on the last whorl; a weak interstitial row of gemmae lies between each pair of major ones on upper surfaces of whorls. Base flat or slightly convex, bearing three widely spaced rows of low gemmae, the innermost close to the columella. Columella narrow, not expanded into a basal callus.

Operculum: Unknown.

DIMENSIONS. Figured specimen, P. 31189: height 19.5 mm, diameter 13.4mm; P. 31188: height 11.8 mm, diameter 11.5 mm; largest fragment observed is 16.5 mm in diameter.

TYPE LOCALITY. Both *Gibbula crassigranosa* and *Astraliu ornatissimu* were described from "Table Cape" (= Fossil Bluff and Freestone Cove, near Wynyard), northern Tasmania.

HOLOTYPE. Tasmanian Museum, Hobart.

MATERIAL EXAMINED. Freestone Cove Sandstone (= Lower bed), Freestone Cove, near Wynyard, northern Tasmania; F. A. Cudmore Colln., NMV, P.31189 (10); Atkinson Colln., NMV, P.31188 (1).

AGE. Longfordian (basal Miocene Australian local stage).

Ludbrook (1967, pl. 2, figs. 16, 18) figured the holotypes of *Astraliu ornatissimu* and *Gibbula crassigranosa*. Later photographs of the holotype of *Astraliu ornatissimu* show it to be a worn, broken, juvenile specimen of *Bolma crassigranosa*. The two names were proposed at the same time and, although the name *ornatissimu* has page priority, as first revisers we choose the name *Astraliu crassigranosu* as the valid name to be used for the taxon because it is based on a better specimen. May (1919, p. 70) also noted that, from comparison of "cotypes", *G. ornatissima* and *A. crassigranosa* are "scarcely distinct." *Bolma crassigranosa* is easily distinguishable from all other Australian fossil species of *Bolma* by its tall spire and its coarse sculpture of two main rows of large gemmae.

***Bolma bartschi* Dall, 1913**

Fig. 6a-h

Bolma bartschi Dall, 1913: 591; Dall, 1925: 6, pl. 36, fig. 9; Kosuge, 1972: pl. 4, figs 8, 9.

Turbo asteriola Dall, 1925: 28, pl. 36, figs 1, 7; Kosuge, 1972: pl. 4, figs. 6, 7.

Astraea (?) *asteriola*. — Kuroda & Habe, 1952: 39.

DIAGNOSIS. Shell: Relatively tall spired, with convex shoulders, a wide flat area between basal and peripheral angulations, peripheral spines long in juvenile and very short in adult. Moderately prominent peripheral angulation in centre of spire whorls and at upper third of last whorl, bearing moderately long, narrow, ventrally directed spines (12 on last whorl) in juvenile but, as usual in *Bolma*, spines become progressively smaller during growth so that last whorl of adult bears 15 low, scale-like nodules. Basal angulation prominent, bordered by a narrow, squamose cord. Sculpture of whorl upper surfaces consisting mainly of a prominent subsutural row of rounded, closely spaced gemmae, approximately 27 on last whorl of juvenile and 29 on last whorl of adult, with a few sparse rows of low, rounded gemmae developing down the spire on the gleaming, weakly

spirally lirate area between subsutural cord and periphery; row below subsutural cord develops on second whorl of juvenile specimen and fifth row of adult specimen; adult develops progressively more cords to bear three intermediates on this area on last part of last whorl. Area between angulations weakly spirally lirate in juvenile, bearing fine, regular, smooth, spiral threads in adult, about 17 on last whorl of holotype. Base shining and faintly spirally lirate in juvenile, with about 15 weak, smooth, spiral threads in adults, the six near the margin regular and close as on lateral area, the rest low, widely spaced and ill-defined. Basal callus very thin, transparent, polished, spread over about $\frac{1}{8}$ of base near inner lip in juvenile, $\frac{1}{3}$ of base in adult. Surface between suture and periphery marked light and dark purplish red to magenta, peripheral and basal angulation cords light magenta red between white or pink nodules and spines, a few light magenta red axial flames on vertical lateral areas, rest of shell pale cream; parietal wall and narrow basal area near columella white, inner edge of columella nacreous, outer edge of columella white; entire surface with a nacreous gleam.

Operculum: White, thick and strongly convex with a weakly granular, very slightly depressed centre in juvenile; relatively thin and weakly convex with very weakly defined spiral groove in centre and faint, concentric, marginal striations in adult.

DIMENSIONS. Holotype of *B. bartschi*: height 30 mm, diameter 35 mm; holotype of *B. asteriola*: height 14 mm, diameter 20 mm (including spines).

TYPE LOCALITIES. *Bolma bartschi*: Albatross Stn 5629, off Dowarra Is., near Ternate, Moluccas, 375 m; *B. asteriola*: Albatross Stn 4924, Colnett Strait, eastern Sea of Japan, 291 m.

HOLOTYPE. Both in USNM; *B. bartschi*, 214444; *B. asteriola* 205733.

Examination of the holotypes of *Bolma bartschi* and *Turbo asteriola* suggests that the specimen of *T. asteriola* is a juvenile specimen of *B. bartschi*. It agrees with the much larger holotype of *B. bartschi* in its cream and red colour, its shape and its sculpture, but differs in having longer spines, pink (instead of white) subsutural nodules without the reddish purple between them, with secondary gemmules commencing after $2\frac{1}{4}$ whorls (compared with after $4\frac{3}{4}$ whorls (i.e. first $\frac{1}{4}$ of body whorl) in *bartschi*) and a markedly more convex operculum. The apical spines are obviously broken off the holotype of *B. bartschi* and the spines presumably decrease in length down the shell as happens in other species of *Bolma*, so that this feature is presumably correlated with the small size of the holotype of *B. asteriola*. The differences observed in the operculum are probably due to a change with growth; as it becomes more flattened it develops a weak central spiral groove in the larger specimen. Only these two specimens of *B. bartschi* are known to us.

The other differences noted above between the 2 holotypes do not seem to us to be of sufficient magnitude to separate them as different species.

***Bolma flindersi* (T. Woods)**

We consider the following two Australian Tertiary taxa to be subspecies in the lineage of *Bolma flindersi*.

***Bolma flindersi darraghi* n. subsp.**

Fig. 5a-h

DIAGNOSIS. Shell: Small, spire moderately tall, depressed pagodiform, with narrowly channelled sutures, usually with 3 rows of short spines on body whorl. Peripheral angle at about lower $\frac{1}{3}$ on spire whorls and about middle of body whorl;

bearing moderate to short, hollow, forwardly directed, horizontal to slightly upwardly directed spines, 15-18 on body whorl. A row of short spines, intermediate in size between the peripheral spines and the scales on the basal angulation, lies in the lightly convex space between the two angulations. Base with 5-6 close, scaly spiral cords and upper surface of body whorl with 4 well-spaced, gemmate, spiral rows of granules, the uppermost (subsutural) strongest, the remainder decreasing in strength towards the periphery. Fine growth lamellae strongly prosocline. Mature aperture and basal callus not seen. Basal callus very narrow; separated from columella by a weak depression in subadult.

Operculum: Unknown.

DIMENSIONS. Holotype: height 13.00 mm, diameter 14.02 mm; figured paratype: height 11.96 mm, diameter 12.94 mm.

TYPE LOCALITY. Brown's Creek Clay, below *Notostrea* greensand, Washout 1, nearest Brown's Creek, Johanna, coast west of Cape Otway, Victoria. Coll. T. A. Darragh, 20 Nov. 1970, holotype and 7 paratypes.

HOLOTYPE. NMV, P.30767.

OTHER MATERIAL EXAMINED. As above, 9.4 m below *Notostrea* greensand, Washout 1, nearest Brown's Creek, Johanna, coast west of Cape Otway, Victoria. Coll. T. A. Darragh, 24 Feb. 1971, 4 paratypes (NMV, P.30768). Pallinup Formation, 25 km N. of Walpole townsite along Thomson Highway, Western Australia. Coll. T. A. Darragh and G. W. Kendrick, 30-31 August, 1973 (4) (WAM 78.922); (3) (NMV, P. 47775-6).

AGE. Aldingan (Upper Eocene Australian local stage).

The new subspecies differs from *B. flindersi flindersi* in having a more pagodiform whorl outline, a shorter spire, a much stronger basal angulation, narrower spines, and sculpture of more numerous rows of finer gemmae. It seems likely that *B. flindersi darraghi* is the direct ancestor of *B. flindersi flindersi*. Three specimens (NMV, F.30747 (2 specimens) and NZGS, WM11742 (1 specimen)) from the Jan Juc Formation at Bird Rock Cliffs, Torquay, Victoria (Janjukian Stage, Oligocene) are slightly smaller than *flindersi flindersi*, are of similar outline and resemble in most details the Eocene shells from Johanna, but have very markedly longer peripheral spines (fig. 3c). They are interpreted as a long-spined form intermediate between *B. flindersi darraghi* and *B. flindersi flindersi* in an evolutionary lineage. The Western Australian Eocene specimens have no spines, probably due to wear, and up to 6 (instead of 4) rows of gemmules on the shoulder (fig. 5f-h). They probably represent a geographic form of *B. flindersi darraghi* but are not named because of the poor condition of the material.

The new subspecies is named for Mr T. A. Darragh, Deputy Director, National Museum of Victoria, who recognised the subspecies as new and generously consented to our naming it, and who has kindly made available to us most of the Australian fossil material we have examined.

Bolma flindersi flindersi (T. Woods, 1877)

Fig. 4d-j

Astralium (Calcar) flindersi T. Woods, 1877: 95; May, 1919: 71, pl. 10, fig. 11.

Calcar flindersi. — Cossmann, 1918: 145.

Astralium flindersi. — Pritchard, 1896: 116; Darragh, 1970: 169.

DIAGNOSIS. Shell: Relatively tall spire, small, with narrowly channelled suture, flat whorls with granulose to scaly sculpture and rudimentary or short peripheral spines. Peripheral angulation sharp on all whorls, very low on spire whorls, a narrow channel usually present below. Spines short or reduced to nodules and very variable in size and number (the extent of variation is shown in fig. 4d-j). Basal angle usually poorly defined or absent, in some specimens represented by a spiral row of short scales or gemmules larger than in other rows. Two spirals immediately below periphery may form a weak basal angulation, are equally prominent in some specimens or are both indistinguishable from remainder of basal spirals in some specimens. Base bearing 5 gemmate cords. One cord (sometimes 2) immediately below sutural channel more strongly gemmate than the 4-6 others on upper surface of penultimate whorl. Body whorl with up to 10 spirals. Ornament on spiral ribs varies from rounded gemmae to short scales. Whole surface crowded with fine, strongly prosocline growth lines. Basal callus very thin, spread over about $\frac{1}{3}$ of base, separated from columella by a shallow groove.

Operculum: Slightly oval, with strong spiral ridge about midway between outer edge and centre, a shallow groove above and below ridge (3 specimens in NMV, P.30772).

DIMENSIONS. Holotype: height 17 mm, diameter 13 mm.

TYPE LOCALITY. "Table Cape" (= Fossil Bluff, Wynyard), Tasmania.

HOLOTYPE. Apparently lost (not recorded by Ludbrook, 1967).

OTHER MATERIAL EXAMINED. "Table Cape" (Freestone Cove Sandstone, Fossil Bluff and Freestone Cove, near Wynyard), north coast of Tasmania, AM (5), NMV (many).

AGE. Longfordian (basal Miocene Australian local stage).

Bolma flindersi is similar to, but smaller than, both *B. guttata bathyraxis* (Smith) and the Italian Pliocene *B. castrocarensis* (Foresti) (Sacco, 1898, pl. 1, fig. 39, 40). The basal angulation is weak or absent in *B. flindersi* although the periphery is sharply angled, whereas there is a marked lower basal angulation in *B. guttata bathyraxis* and a regularly rounded periphery and base in *B. castrocarensis*. *Bolma castrocarensis* has even more poorly developed peripheral spines than *B. flindersi*. The basal callus is more weakly developed in *B. flindersi* than in either similar species. *B. somaliensis* sp. nov. is similar to *B. flindersi* and is contrasted below.

***Bolma guttata* (A. Adams, 1863)**

Three geographic subspecies are recognised as comprising this species. The overall features of similarity are a prominent sutural channel, numerous, short peripheral spines and a rather weak basal angle. Only 1-3 spiral cords lie between the basal and peripheral angles. The basal callus is very thin and transparent, white, and separated from the columella by a shallow groove. The operculum is subcircular and has weak concentric striae around the edges of the central area which is weakly pustulose. The colour in all forms is mauve-pink, usually with a few purple blotches.

This species is very similar to *B. marshalli* (Thomson), which differs mainly in its stronger basal angle, finer sculpture and thicker and wider basal callus which is not separated from the columella by a groove. The operculum is also flatter and thinner. It also closely resembles *B. persica* (Dall) which, however, has a relatively shorter spire, much longer peripheral spines, weaker sculpture and no sutural channel.

***Bolma guttata bathyraphis* (E. A. Smith, 1899)**

Figs 7a-g; 8a-m; 19c-d

Astraliu bathyraphe E. A. Smith, 1899: 247; E. A. Smith, 1901: pl. 12, figs. 4-4c.*Astraliu (Cyclocantha) gilchristi* G. B. Sowerby 3rd, 1903: 221, pl. 5, fig. 6.*Astraea gilchristi*. — Barnard, 1963: 221, fig. 7c.

DIAGNOSIS. Shell: Spire moderately tall; sutures channelled, with flat-sided to lightly convex whorls and finely to rather coarsely gemmate sculpture. Peripheral angulation sharp on spire, where it is near base of whorls; last whorl sometimes rounded. Body whorl with 4-7 spiral rows of rounded to weakly scaled gemmae below suture, uppermost slightly stronger than others; peripheral sculpture subspinose to spinose, 20-30 spines when present; spines short, hollow, triangular. 1-3 rows of gemmae below peripheral angle and a third, heavier row of smooth or weakly scabrous nodules on rather weak basal angulation. About 4-8 rows of smaller gemmae on base. Entire surface crossed by prosocline axial lamellae, sometimes very distinct. Basal callus moderately expanded, thin, transparent, whitish, separated from white columella by a groove. Outer lip slightly reflected above. Surface pale fawn to pinkish-mauve sometimes with darker mauve blotches.

Operculum: Nearly circular, thickly convex, with faint, closely spaced spiral grooves around the margin; central area somewhat flattened with a few indistinct wrinkles, white.

DIMENSIONS. *A. bathyraphe*, holotype: height 34 mm, diameter, 33.7 mm. *A. gilchristi*, holotype: height 26.9 mm, diameter (including spines) 29.4 mm. Squamose specimens from Maldivé Ids, 229 m: height 38.6 mm, diameter 35.7 mm; height 35.8 mm, diameter 31.7 mm.

TYPE LOCALITIES. *A. bathyraphe*: N. Maldivé Atoll, N. Indian Ocean, 384 m ("Investigator" Stn 218). *A. gilchristi*: Bearing N.W. $\frac{1}{4}$ W, 15 km from O'Neil Peak, Natal, 165 m.

HOLOTYPE. *A. bathyraphe*: Zoological Survey, Calcutta, M579. *A. gilchristi*: SAM, A.5219.

OTHER MATERIAL EXAMINED. 23°36.3'S, 43°32.5'E, off Tuléar, S. W. Malagasy Republic, 250 m, 28 Feb., 1973, A. Crosnier Colln (AMS) (3); as last, 23°35.9'S, 43°32.7'E, 285-305 m, 27 Feb., 1973 (AMS) (1 broken); 12°41.3'S, 48°16'E, off Nossi Bé, N. W. Malagasy Republic, 308-314 m, 15 April, 1971, A. Crosnier Colln (AMS) (2); as last, 12°51.0'S, 48°06.3'E, 675-705 m, 14 Sept. 1972 (AMS, NM) (5); Bay of Bengal, "Investigator" Stn (no other data), Melvill — Tomlin Colln (NMW) (1); John Murray Expedition, Stn 157, 4°43'48" N to 4°44'00" N, 72°55'24" E to 72°54' 18" E, 229 m, coral rubble bottom, Maldivé Ids, Indian Ocean, 6 April, 1934 (BMNH) (3).

OTHER LOCALITIES. *South Africa*: Scottsburg Lighthouse, Natal, bearing N.W. by N., distant 12.8 km, 168 m; off Port Shepstone, 457 m; off Cape Natal, 99 m; off Cape Vidal, 146-183 m; off Durnford Point, 165 m; all from Barnard (1963, p. 221).

An examination of the small amount of material available to the writers has indicated that one rather variable subspecies of the *guttata* group can be recognized in the western and northern Indian Ocean. Specimens from S. W. Malagasy Republic and S.E. Africa (including the type of *Astraliu gilchristi*) are similar in having a distinctly spinose periphery, flat whorls, and a colour pattern of dark blotches (figs. 7a-g; 8a-m). Of the two

lots available from N. W. Malagasy Republic, one is like *gilchristi* and the other 5 specimens from deeper water are more heavily beaded, non-spinose, have a uniform colour pattern, develop weak spiral striae over the closely packed gemmae and have a yellowish edge to the basal callus (figs. 8d-f). These latter specimens are somewhat similar to the type of *B. guttata bathyraphis* (figs. 7e-g) from the Maldiv Islands in general form but that specimen is a little larger, has stronger gemmae and lacks the secondary spiral striae and yellow-edged callus. In most respects the holotype of *bathyraphis* shows intermediate shell characters between *gilchristi* and the non-spinose shells from N.W. Malagasy Republic. A lot of 3 specimens, also from the Maldiv Islands, have weakly convex whorls and distinctly scaly sculpture (figs. 8g-m). A single specimen from the Bay of Bengal has a weak subsutural channel and is, in this respect, and in having a lightly convex shoulder on the body whorl, similar to *B. guttata millegranosa*. It is, however, like *B. guttata bathyraphis* in other characters.

Finlay (1926, p. 367) commented that *B. guttata bathyraphis* is similar to "*Incilaster*" *marshalli* (Thomson) but the similarity of *B. guttata bathyraphis* is much greater to *B. flindersi flindersi* (T. Woods) and the Italian Pliocene *B. castrocarensis* (Foresti) (Sacco 1896, pl. 1, fig. 39, 40), although *B. flindersi* is much smaller and not closely related. *B. guttata bathyraphis* has fewer rows of more rounded nodules, a more clearly differentiated row of peripheral nodules, a more marked sutural channel and a more marked basal angulation than those of *B. flindersi*. *Bolma castrocarensis* does not have differentiated peripheral nodules and has more convex whorls than *B. guttata bathyraphis*, its sculpture consisting of seven or eight lateral rows of large, rounded, slightly laterally compressed nodules and five or six basal rows of slightly smaller nodules. The basal callus is broad and thick in *B. castrocarensis*, but narrow in *B. guttata bathyraphis*, and the two forms are probably not closely related.

***Bolma guttata guttata* (A. Adams, 1863)**

... Figs 9i-m; 19 e-f

Modelia guttata A. Adams, 1863: 507

Turbo (Modelia) guttata. — G. B. Sowerby 3rd, 1886: 206, pl. 499, fig. 68.

Turbo (Modelia) amabilis Ozaki, 1954: 11, pl. 4, figs. 1-3.

Turbo guttatus. — Kuroda & Habe, 1952: 93.

Bolma guttata. — Oyama & Takemura, 1960: *Bolma*, figs. 9-11.

Galeoastrea guttata. — Habe, 1961: 14, pl. 7, fig. 17; Habe, 1964: 21, pl. 7, fig. 17; Kuroda *et al.*, 1971: 48, pl. 14, fig. 3, 4; Okutani, 1972: 78, pl. 1, figs. 5, 6.

DIAGNOSIS. Shell: Solid, with rounded body whorl and weakly convex spire whorls, weakly channelled suture, short spines and heavy, gemmate spiral cords. Peripheral angle low on whorls of spire, rounded on body whorl, with short, hollow spines, about 26 on body whorl. Basal angulation represented by the second basal spiral cord which is very slightly more prominent than the first. Five additional cords on base and 5 above periphery, the uppermost strongest. Growth lamellae fine and weak, strongly prosocline. Basal callus expands over $\frac{1}{4}$ of base, very thin, transparent, colourless, separated from the white columella by crescent-shaped depression. Outer lip slightly reflected and expanded. Surface pinkish-mauve, with small dark reddish-mauve blotches.

Operculum: Oval, white, with a slight depression off centre in adult, juvenile with marked central depression. Marginal area a narrow flattened rim, central area rather flat-topped, weakly pitted, sides of central area with few irregular concentric striae.

DIMENSIONS. Holotype: height 40 mm, diameter 39.4 mm; figured specimen: height 31 mm, diameter 33 mm.

TYPE LOCALITY. "Tatiyama", Japan (= Tateyama, Sagami Bay).

HOLOTYPE. BMNH, 1968210.

OTHER MATERIAL EXAMINED. Several of the specimens recorded by Okutani (1972) from three submarine banks near the Izu-Shichito Ids (Tokai Regional Fisheries Laboratory); Okinose Bank, off Sagami Bay, central Honshu, 48 m (NSMT) (1).

OTHER LOCALITIES. "Mainly found in Sagami Bay, Honshu at depths of 50-200 m" (Habe 1964, p. 21); Okutani (1972) noted that this subspecies may be one of the most common prosobranchs on the submarine banks near the Izu-Shichito Islands; six localities in Sagami Bay (Kuroda *et al.*, 1971, p. 48). The geographic range is Honshu (Sagami Bay to off Choshi City) and around the Izu Islands, on fine sandy and gravelly substrates in depths of 50-200 m (Kuroda *et al.*, 1971). Recorded as a Pliocene fossil (*B. amabilis*) from Tyosi, Japan, by Ozaki (1954, p. 11); as noted by Habe (1958, p. 55) this name appears to be based on fossil specimens of *B. guttata guttata*.

Bolma guttata guttata differs from the other subspecies in its shorter spines and much coarser sculpture. Dr. Tadashige Habe noted (*in litt.*, 8 Nov. 1975) that *B. guttata millegranosa* seems to be a subspecies of *B. guttata* "from Sagami Bay", having a different operculum.

***Bolma guttata millegranosa* (Kuroda and Habe, *in* Habe, 1958)**

Fig. 9a-d

Astraea (*Bolma*?) *persica*. — Hirase, 1938: 41, pl. 74, fig. 7 (not *Bolma persica* Dall, 1907).

Bolma? *millegranosa* (Kuroda & Habe, MS) Kira, 1955: 20, pl. 10, fig. 3 (*nomen nudum*).

Bolma millegranosa. — Oyama & Takemura, 1960: *Bolma*, fig. 1-3.

Galeoastraea millegranosa. — Kuroda & Habe *in* Habe, 1958: 45, pl. 3, fig. 1 (radula); Kira, 1962: 18, pl. 11, fig. 3.

Galeoastraea (*Hirasazaea*) *millegranosa*. — Kira, 1961: 20, pl. 10, fig. 3.

DIAGNOSIS. Shell: Whorls slightly convex, sutures weakly to moderately channelled, spines rather long for species, sculpture of moderately strong, gemmate spiral cords. Peripheral angle sharp on early whorls, slightly overhanging later whorls. Periphery bluntly angled on body whorl, with about 22-28 hollow, rather short, slightly downwardly directed spines on body whorl. Basal angle distinct, granulate, the space between basal and peripheral angles flat, with 1 weakly gemmate spiral thread. Base with 6 weakly gemmate threads, becoming stronger towards the columella. Upper surface of whorls with a moderately strong row of granules a little below the suture, followed by 5-7 gemmate spirals on penultimate whorl, 6-8 on body whorl. Basal callus very thin, white near columella, remainder transparent, separated from columella by a groove, extending over about $\frac{1}{3}$ of base. Surface pinkish-fawn, with purplish-brown blotches on upper surface. Outer lip reflected when mature.

Operculum: Oval, almost circular, with steep concentrically striated sides and flattened pustulose central area. Central area higher opposite nucleus than above nucleus.

DIMENSIONS. Holotype: height 23.5 mm, diameter 26.5 mm (Dr. T. Habe, *in litt.*); paratype: height 40.0 mm, diameter 41.9 mm (Dr. T. Habe, *in litt.*). Figured specimens: height 29.5 mm, diameter 31.3 mm; height 41.0 mm diameter 39.1 mm; large specimen: height 46.3 mm, diameter 44.2 mm.

TYPE LOCALITY. Tosa Bay, Shikoku, Japan, ca. 100 m (Dr. T. Habe, *in litt.*).

TYPES. NSMT, 59903; single paratype, NSMT, 59904.

MATERIAL EXAMINED. Tosa, Japan (ANSP) (4); (Bishop Mus., Honolulu) (2); Japan (ANSP) (2); Kii, Japan, (AMNH) (2); (Bishop Mus., Honolulu) (2); Off S. end of Frazer Is., Queensland, 25°57.8'S, 153°51.3'E, 201 m, (AM) (2 + fragments); same data as last, 25°58.8'S, 153°51.0'E, 210-219 m (AM) (4 juveniles).

OTHER LOCALITIES. Japan: Southern part of Honshu and Shikoku in 91-146 m (Kira, 1962, p. 18); Tosa Bay, Shikoku (Oyama & Takemura, 1960: *Bolma* pl. 1). The subspecies does not overlap the geographic range of *B. guttata guttata* (A. Adams), which occurs further north around Sagami Bay.

Bolma guttata millegranosa differs from *B. guttata guttata* in its finer sculpture of more numerous rows of gemmae, in having a flattened, steep-sided rather than convex operculum and in its longer spines; from *B. guttata bathyraphis* in its more inflated whorls, its slightly coarser sculpture and its downwardly directed peripheral spines, and from *B. persica* (Dall) in its coarser gemmae, its much shorter peripheral spines, and its more inflated whorls. The eastern Australian specimens agree in nearly every respect with Japanese material and it is surprising that no other records from the rest of the western Pacific are available.

As with several other species of Japanese molluscs, the manuscript name *millegranosa* of Kuroda and Habe was first introduced as a *nomen nudum* when it was published by Kira (1955, p. 20) as no statement was given to differentiate the taxon (International Code of Zoological Nomenclature, Art. 13a). As Habe (1958, p. 45) was the first to associate a statement of differentiation with the name (International Code of Zoological Nomenclature, Art. 24b) when he distinguished the radula from that of *Bolma modesta* (Reeve) and as he attributed the name to Kuroda & Habe, we agree with Dr. Habe (*in litt.*, 8 Nov. 1975) that the name should be attributed to Kuroda & Habe *in* Habe (1958, p. 45). Dr. Habe has noted that the holotype (details above) is the specimen from which his illustrated radula was removed.

***Bolma guttata* subsp.?**

Fig. 9e-h

DIAGNOSIS. Shell: Two immature specimens resembling *B. guttata millegranosa* in most features (larger described). Peripheral spines longer than on *B. guttata millegranosa*, with 12 on last whorl (about 17 per whorl at equivalent stage of *B. guttata millegranosa*), whorls more flat-sided and spiral sculpture weaker than in *B. guttata millegranosa*. In the last two features it resembles *B. guttata bathyraphis* but differs in its fewer, longer, downwardly directed spines (21-25 per whorl at same stage in *B. guttata bathyraphis*). A prominent basal angulation bears a strongly gemmate cord. Concave area

between peripheral and basal angulations bears a single, weakly gemmate spiral thread, base bears 5 weak, gemmate cords. Whole surface crossed by conspicuous, strongly prosocline growth lamellae. Basal callus white, narrow. Surface pinkish fawn with small, irregular, pale purplish blotches on upper surface and on spines.

Operculum: Almost circular, thick, slightly flattened in centre, coarsely and irregularly granulate over most of surface, with narrow marginal zone of irregular concentric grooves; white.

DIMENSIONS. Larger: height 15.73 mm, diameter (including spines) 22.35 mm; smaller: height 5.23 mm, diameter 8.45 mm.

MATERIAL EXAMINED. Between Shark Bay and Onslow, Western Australia (WAM 603-70, 1 juvenile, larger); approx. 274 km W. of Port Hedland, Western Australia, 19°29'S, 116°01'E, 137 m (AM, C.96325, 1 juvenile, smaller).

This form possibly represents an unnamed subspecies, but adult material is needed to confirm its features.

***Bolma henica* (Watson, 1885)**

Figs 10a-h; 19a,b

Turbo (Calcar) henicus Watson, 1885: 73; Watson, 1886: 130, pl. 6, fig. 11.

Astralium henicum. — Thiele, 1903: 121, 163, pl. 8, fig. 45 (radula).

Calcar henicum. — Martens, 1903: 46.

Astralium (Pseudastralium) abyssorum Schepman, 1908: 27, pl. 2, fig. 1.

Astraea (Calcar) henica. — Nomura & Zinbo, 1934: 146.

Astraea (Pseudastralium) abyssorum. — Hirase, 1938: 42, pl. 74, fig. 10.

Guildfordia abyssorum var. — Taki, 1951: pl. 74, fig. 10.

Guildfordia henicus var. — Kuroda & Habe, 1952: 59.

Pseudastralium henicus gloriosum Kuroda & Habe in Kira, 1955: 20, pl. 10, fig. 2 (*nomen nudum*).

Guildfordia (Pseudastralium) henicus gloriosa. — Oyama & Takemura, 1957: *Guildfordia*, fig. 1-4 (*nomen nudum*).

Pseudastralium cf. *henicus*. — McNeil, 1960: 33, pl. 11, fig. 9, 10.

Guildfordia (Pseudastralium) gloriosa. — Kuroda & Habe in Kira, 1961: 20, pl. 10, fig. 2; Kira, 1962: 19, pl. 11, fig. 2.

DIAGNOSIS. Shell: Spire moderate to low, whorls flat, sculpture of rather short spines and scaly (sometimes gemmate) spirals; sutures strongly channelled. Shoulder flat, to slightly concave, edge bordered by a row of large, white beads between which and periphery are up to 7 rows of small beaded spirals which often do not commence for 2-3 whorls. Periphery sharply angled, bearing up to about 17 rather long, curved, hollow spines on body whorl. Basal angulation prominent, weakly to strongly gemmate or scaly. Space between peripheral and basal angulation flat, bearing 0-5 scaled (or sometimes beaded) spirals. Base with up to 10 scaled (or sometimes beaded) spirals, smooth in small specimens. Growth lamellae fine, strongly prosocline. Basal callus narrow, white, not separated from columella. Colour light yellowish-pink, base paler than upper surface.

Operculum: Oval, rather flattened in centre, with steep edges and a very slight flange on outer lower margin, weakly granulose in centre, with faint concentric marginal striae; white.

DIMENSIONS. Lectotype of *T. henicus*: height 21.6 mm, diameter 26.5 mm (including spines), 22.2 mm (excluding spines). Lectotype of *A. abyssorum* (from original description): height 17 mm, diameter (excluding spines) 24 mm. Large specimen: height 28.4 mm, diameter (including spines) 26.5 mm, diameter (excluding spines) 21.0 mm.

TYPE LOCALITIES. *T. henicus*: 19°9'35" S, 179°41'50" E, off Matuku, Fiji Ids, 576 m, H.M.S. "Challenger" Stn 173. *A. abyssorum*: not specified by Schepman (1908, p. 27), who listed 7 localities in depths of 189 to 520 m, in and around the Straits of Samau, Indonesia, taken by the "Siboga" Expedition. His figured specimen is from "Siboga" Stn 59, western entrance to Samau Strait, Indonesia, 10°22.7'S, 123°16.5'E, 390 m, and this specimen is here designated the lectotype of *Astralium* (*Pseudastralium*) *abyssorum* Schepman, 1908 (fig. 10a-c). *P. gloriosum*: Southern parts of Honshu and Shikoku, as deep as 91-146 m (Kira 1961; Kira 1962); exact locality not known to us.

TYPES. *T. henicus*: lectotype (here designated), the larger of 2 syntypes in BMNH, 87.2.9. 453, paralectotype 87.2.9.454. 3rd syntype (i.e. paralectotype) in NMW, ex. McAndrew Colln. *A. abyssorum*: lectotype (here designated), Zoölogisch Museum Amsterdam, 2532. *P. gloriosum*: not known to us.

OTHER MATERIAL EXAMINED. Tosa Bay, Japan, 146 m (3), 220 m (2), 274 m (2) (AMNH); Tanabe, Japan (Bishop Museum, Honolulu) (1); Tosa Bay, 220 m (1), depth not known (11) (ANSP), (2 lots, each 1 spec.) (USNM); Shikoku, Japan (ANSP) (2); Molucca Passage, between Gillolo Is. and Makyan Is., 498 m (USNM) (3); Sibuko Bay, Borneo, S.E. of Mabul Is., 597 m (USNM) (3); Sibuko Bay, Borneo, S. of Silungau Is., 588 m (USNM) (1); "Valdivia" Stn 192, 0°43'S, 98°34'E, off Pandang, Sumatra, Indonesia, 371 m; Stn 193, 0°30'S, 98°0'E, off Sumatra, Indonesia, 132 m (1 juvenile, possibly this species); Stn 209, 6°56'S, 93°33'E, off Sumatra, Indonesia, 362 m (2) and Agulhas Bank, South Africa (1) (all Humboldt University Museum, E. Berlin); "Siboga" Expedition Stns 12, 7°15'S; 115°15.6'E, Java Sea, 289 m (4); Stn 89, Pulu Kaniungun Ketjil, Indonesia, 11 m (1); Stn 139, 0°11'S, 127°25'E, Molucca Sea, 397 m (Schepman's illustrated radula removed from this specimen); Stn 156, 0°29.2'S, 130°5.3'E, Halmahera Sea, 469 m (3); Stn 159, 0°59.1'S, 129°48.8'E, Halmahera Sea, 411 m (1); Stn 279 Rumah-Kuda Bay, Roma Is., Indonesia, 36 m (1) (all Zoölogisch Museum, Amsterdam); 3 km off Laulasi Village, S. of Aoki, N.W. coast of Malaita Is., Solomon Ids, 365 m (1 juvenile, probably this species) (AM); Great Barrier Reef Expedition dredge Stn 15, 384 m, 0.8 km outside Cook's Passage, Queensland (AM, C77149) (1); E.N.E. of Clarence River mouth, northern New South Wales, 457 m, F.R.V. "Kapala" Stn K75-09-08, 29°26'S, 153°49'-50'E (ca. 100, most in AM, 3 in NZGS).

OTHER LOCALITIES. Southern parts of Honshu and Shikoku, Japan, as deep as 91-146 m (Kira, 1961; Kira, 1962). Recorded as a fossil from the Pliocene Chinen Sand of Okinawa and Ryukyus Limestone of Kikaiga-shima, Ryukyu Islands, by McNeil (1960) and Nomura & Zinbo (1934).

This species exhibits variation in the degree of spiral sculpturing, some specimens being almost smooth (except for the subsutural and subperipheral cords and the peripheral spines). Intergrading sculptural forms have, however, been observed from several localities. The observed shell variation encompasses the forms included in the synonymy.

Barnard (1963, p. 219) suggested that von Martens' (1903) record of *henica* from South Africa was probably *B. tayloriana* or possibly *B. gilchristi* (= *B. guttata bathyraphis*

herein). Examination of the "Valdivia" specimens has shown that von Martens' identification is the correct one.

The species name *gloriosum* of Kuroda & Habe, MS, first published by Kira (1955, p. 20), is a *nomen nudum* as no statement was given to distinguish it from related taxa (International Code of Zoological Nomenclature, Art. 13a). A description was first associated with the name by Kira (1961, p. 20) and, as with several other Japanese mollusc names, we consider the authorship should be attributed to Kuroda & Habe *in* Kira, 1961.

***Bolma kermadecensis* n. sp.**

Fig. 12h-j

DIAGNOSIS. Shell: With rounded whorls, deeply incised suture and few, long peripheral spines. Teleoconch of $5\frac{1}{2}$ whorls; peripheral angle slightly below middle of whorls with 1 row of 7 long, heavy spines on body whorl, 11 (all but one broken) on penultimate whorl. Spines directed forwards and slightly downwards, very small on upper spire whorls. Shoulder convex, with 10 spiral rows of rather widely spaced small gemmae on body and penultimate whorls, subsutural row not stronger than others. Basal angle very weak, marked by a gemmate spiral cord slightly stronger than the other basal spirals; 5 weak spirals above "basal angle" and 9 below. Whole surface crossed by prosocline growth rugae. Basal callus thin (slightly immature), spread over approximately $\frac{1}{3}$ of base, white, with pale yellow tinge near columella. Columella with shallow, longitudinal groove. Colour rather dark pinkish-fawn, with diffuse dark purple blotches on shoulder.

Operculum: Not known.

DIMENSIONS. Holotype: height 36.0 mm, diameter (including spines) 47.0 mm, (excluding spines) 34.5 mm.

TYPE LOCALITY. NZOI Stn K854, $30^{\circ}33.0'S$, $178^{\circ}31.7'W$, east of Curtis Is., Kermadec Ids, 165-135 m, M.V. "Tangaroa", 30th July 1974.

HOLOTYPE. NZOI, H235.

OTHER MATERIAL EXAMINED. NZOI Stn K826, $28^{\circ}48'S$, $177^{\circ}48'W$, N.E. of Raoul Is., Kermadec Ids., 160-210 m (paratype (fragment of body whorl), NZOI, P336).

This species, known only from 1 complete subadult specimen and one large fragment, is very distinctive. The small number of spines on the last whorl, the finely sculptured base, the lack of differentiation of the subsutural row of gemmules, and the very weak basal angulation are a combination of features not observed in any other species. It is superficially similar to *B. girgylla* (Reeve) but differs from that species in its smaller size, the single row of spines on the last whorl, and the finer sculpture. It is probably allied to *B. guttata* (Adams) but it differs in its finer sculpture, strongly convex whorls, the small number of long spines on the body whorl, and the very weak basal angle. *B. tamikoana flava* nov. is similar in having a weak basal angle but does not have a well-developed sutural channel, has only a weakly convex body whorl, has more numerous, small spines, and has coarser and more numerous gemmate spirals.

***Bolma marshalli* (Thomson, 1908)**

Fig. 11a-d

Turbo marshalli Thomson, 1908: 103, pl. 14, fig. 6; Suter 1915: 3.

Incilaster marshalli. — Finlay, 1926: 367, pl. 18, figs 20-23; Olson *in* Gage, 1957: 116; Fleming, 1966: 40.

DIAGNOSIS. Shell: Spire of medium height, suture broadly channelled, peripheral spines short, and spiral sculpture relatively weak. Peripheral and basal angulations both prominent, and separated by a relatively wide, flat area. Subsutural shoulder area relatively wide, weakly concave. Sculpture, in descending order: two horizontal, closely spaced rows of rounded gemmae, the outer the larger and at the subsutural angulation; five rows of small pointed nodules, developed from two rows and their interstitial threads of early spire whorls; a row of 12 low, spinose, peripheral nodules; three closely spaced rows of scale-tipped nodules; a single row of slightly larger, scale-tipped nodules at the basal angulation; and five closely spaced basal rows of scale-tipped nodules. Growth lamellae thin, strongly prosocline. Basal callus thick, spreading over half of base. Outer lip slightly expanded and reflected in mature shells.

Operculum: Convex, with finely granular central area and faint concentric marginal striae.

DIMENSIONS. Figured specimen: height 28.3 mm, diameter 30.3 mm (including spines).

TYPE LOCALITY. Thomson (1908, p. 103) gave no locality for *Turbo marshalli*, other than the area near Kakanui, south of Oamaru, New Zealand, implied by the title of his paper. However, he referred the reader to his earlier paper (Thomson 1906) on the geology of Kakanui district, in which fossils were listed. "*Turbo* n. sp." was recorded on p. 488, in a list of fossils collected from the top, hard, fossiliferous layer of "barren breccia," beneath limestone in a cliff section north of Kakanui North Head (Thomson 1906, p. 487). In modern stratigraphic terminology, these are the Deborah Volcanic Formation and McDonald Limestone, both of Whaingaroan age (lower Oligocene) (Gage 1957, map sheet S136). The locality is that known to present day geologists as "cliffs below Everett's Quarry, Kakanui," where excellent specimens of the fossils listed by Thomson (1906, p. 488) can be collected from the hard, red tuff bed underlying McDonald Limestone in the cliff face below the disused lime quarry. The crystal tuff of the Deborah Volcanic Formation, known to Thomson (1906) as the "mineral breccia," source of the "gem gravels" of Kakanui Beach, is fossiliferous where it crops out at Gees Point, north of Kakanui North Head, but specimens of *Bolma marshalli* have not been collected there, and there is little doubt that the cliff below Everett's Quarry is the type locality.

TYPES. Holotype in Otago Museum, Dunedin, C.03.13, with 2 juvenile paratypes. Suter (1915, p. 4) listed "Primary types (6 shells, 1 operculum)" and the fate of the other specimens is unknown.

OTHER MATERIAL EXAMINED. NZGS fossil locality GS9535, red tuff below McDonald Limestone, cliffs below Everett's (disused) Quarry, Kakanui, south of Oamaru, New Zealand, coll. P. A. Maxwell (3 shells and a number of associated opercula); GS3881, red tuff below Everett's Quarry (1); all NZGS.

AGE. Whaingaroan New Zealand local stage (lower Oligocene).

Specimens from the green tuff at Lorne, Kaiatan Stage (upper Eocene) (GS9481, fallen block of green tuff of Waiareka Volcanic Formation (Gage, 1957, p. 33) in slump at base of William's Bluff, near abandoned Lorne railway station, Waiareka Valley, near Oamaru, New Zealand, coll. P. A. Maxwell, NZGS) (Figs 11e-g) are slightly different from typical *marshalli* in having slightly shorter peripheral spines, less markedly channelled sutures, and a stronger second subsutural row of gemmae which tends to make the shoulder angulation more prominent. This form is tentatively retained in *B. marshalli*.

Bolma marshalli is most similar to *B. guttata bathyraphis*, from which it differs in its shorter spire, thicker basal callus, and different numbers of spiral cords. *B. marshalli* may be ancestral to the Recent *B. guttata* complex.

***Bolma midwayensis* (Habe & Kosuge, 1970)**

Fig. 6i-k

Galeoastrea midwayensis Habe & Kosuge, 1970: 88, pl. 6, figs 4-6.

DIAGNOSIS. Shell: Whorls slightly convex, sculptured with gemmate spiral cords, lacking spines and sutural channel. Periphery rounded. Sculpture of 7 primary and 7 interstitial rows of gemmate spiral cords on upper surface of last whorl, 11-13 on base. Base bearing prominent gemmate spiral cords, gemmae fused into radial ridges in paratype, similar to those of *B. recens*. Basal callus narrow. Outer lip thickened and slightly flared. Surface light brownish-red to yellowish-brown with irregular white maculations, the base pale yellow.

Operculum: Thick, convex, smooth.

DIMENSIONS. Holotype: height 28.6 mm, diameter 29.5 mm; paratype: height 25.0 mm, diameter 27.6 mm.

TYPE LOCALITY. Off Midway Is., central Pacific Ocean. Taken by coral fishing boats.

TYPES. Holotype, NSMT, 37292; one paratype, NSMT, 37293.

Bolma midwayensis is similar to *B. tamikoana* (Shikama) but differs in its inflated whorls, simple sculpture, and complete lack of peripheral spines.

***Bolma persica* (Dall, 1907)**

Fig. 12a-g

Astraea persica Dall, 1907: 167; Dall, 1925: 5, pl. 35, fig. 4, 6.

Bolma persica. — Oyama & Takemura, 1960: *Bolma*, fig. 7, 8.

Galeoastrea persica. — Habe, 1958: 46; Habe, 1961: 14, pl. 7, fig. 16; Habe, 1964: 20, pl. 7, fig. 16; Okutani, 1972: 77, fig. 12.

DIAGNOSIS. Shell: Rather small, spire low, whorls flat-sided, with persistent long spines on all whorls. Body whorl with strong peripheral angle bearing 10-15 triangular, hollow spines, the posterior edges of which are at right angles to shell and form main part of spine. Basal angle rather weakly gemmate, area between it and peripheral angle slightly concave with single very weak spiral thread. Six weakly beaded spirals on upper surface of whorls, 3 on base below basal angle. Growth lines prosocline, fine and sharp. Basal callus very narrow, merely a thickened rim against columella, white. Surface yellowish-white with radial wine-red streaks dorsally and ventrally, and small spots on the gemmae of the spiral threads.

Operculum: Very thick and convex, sides weakly concentrically striated, lightly concave, centre a deep, narrow depression; the raised marginal portion appears to be a tight spiral and is weakly pustulose; white.

DIMENSIONS. Holotype: height 20 mm, diameter 22 mm (excluding spines); figured specimen: height 15.1 mm, diameter 28.35 mm (including spines), 18.5 mm (excluding spines).

TYPE LOCALITY. Off Kagoshima Bay, Japan, 188 m, "Albatross" Stn 4936.

HOLOTYPE. USNM, 110507.

OTHER MATERIAL EXAMINED. Japan: Off Tosa Bay, Shikoku, 200 m (NSMT) (1); 34°28.3'N, 139°11.4'E, 110 m (Tokai Regional Fisheries Lab.) (1); Zenisu Stn 32, near Izu-Shichito Ids, 113 m (Tokai Regional Fisheries Lab.) (1).

OTHER LOCALITIES. Off Kii Peninsula, Japan (Oyama & Takemura, 1960); "rather rarely collected from Tosa Bay, Shikoku to Kyushu at depths of 50-200 m" (Habe, 1964, p. 21). Okutani (1972, p. 77) gave the distribution as from Kagoshima Bay eastwards to Zenisu Bank, probably in 100-200 m.

This relatively small, very long-spined species is related to the *B. guttata* complex. The spines are markedly longer and fewer (10 to 15 on the last whorl), the granular sculpture is finer, the subsutural channel weaker, and the axial growth lamellae more indistinct than in related species.

***Bolma* ? aff. *persica* (Dall, 1907)**
Fig. 3g-i

DIAGNOSIS. Shell: Close to *B. persica* but with coarser granules and spines and more numerous spirals on the base and shoulder. A narrow sutural channel present. Seven primary rows and 3 secondary rows of granules on shoulder at commencement of body whorl and 6 rows on base. Basal angle very indistinct, represented by a row of sharp gemmules with a single weak, spiral cord between this and peripheral row of spines. Spines downwardly pointing, anterior margin upturned to give a double spined effect. Basal callus white, thick, not separated from columella, extending over about $\frac{1}{3}$ of base. Outer lip of aperture thickened within but with sharp edges. Colour purplish pink, some granules white.

Operculum: Almost circular, with flattened central area showing a shallow depression and wrinkled surface. Edges with faint spiral grooves.

DIMENSIONS. Height 27.3 mm, diameter (without spines) 27.1 mm, (with spines) 29.3 mm.

LOCALITY. Off Pratas Island, China Sea, U.S. Bureau of Fisheries Stn 5311, 161 m, coarse shell sand (USNM, 237697) (1).

The single shell shows 3 mended "breaks" following which are changes in details of sculpture and shape (such as the peculiar spines) that may be due to a damaged mantle. Although this specimen may possibly represent an undescribed species it is more likely to be a freak form of *B. persica*.

***Bolma recens* (Dell, 1967)**
Fig. 11h, i

Incilaster recens Dell, 1967: 305, fig. 6, 7, text-fig. 8 (radula).

DIAGNOSIS. Shell: very similar to *B. bartschi*, differing in its slightly taller shape; slightly more prominent spiral threads between the peripheral and basal angulations; in having three equally coarse gemmate cords above the periphery, rather than a markedly coarser subsutural row with other rows extremely fine, as in *B. bartschi*; in having a more

coarsely sculptured base on which the cords are gemmate around the margin of the base and the gemmae are fused into short radial ridges over the inner two-thirds of the base; in having a thicker outer shell layer, and thus lacking the nacreous gleam of *B. bartschi*; and in lacking the striking magenta and cream colour pattern of *B. bartschi*. Colour uniform greyish fawn.

Operculum: Convex, almost circular, with weak pustules in slight central depression, and with weak concentric marginal striations; white.

DIMENSIONS. Holotype: height 31.0 mm, diameter 30.1 mm; paratype: height 29.3 mm, diameter 29.0 mm.

TYPE LOCALITY. Kiwi Seamount, 30°45'S, 173°15'E, between northern New Zealand and the Kermadec Islands, 358-677 m, M.V. "Tui" Stn. AUZ 11.

TYPES. Holotype, N.Z. National Museum, M21297, with one paratype.

OTHER MATERIAL EXAMINED. NZOI Stn 197, 32°22.9' to 23.3'S, 167°28.2'E, Wanganella Bank, Norfolk Ridge, 540-544 m, NZOI (1); NZOI Stn P40, 29°10.2'S, 167°50.0'E, west of Norfolk Is., 394-472 m, NZOI (1); NZOI Stn J659, 35°00.6'S, 179°15.1'E, Silent 1 Seamount, S. Kermadec Ridge, off East Cape, New Zealand, 689 m, NZOI (1).

The differences in basal sculpture, shell structure and colour pattern suggest that the similarity of *B. recens* to *B. bartschi* is probably superficial.

Bolma recens differs from *B. marshalli* in its larger size, taller spire, wider area between the peripheral and basal angulations, markedly finer sculpture, and fusing of basal granules into radial ridges. Possibly *B. recens* is descended from *B. marshalli* but the differences are too large and the age difference too great to be sure of the relationship.

***Bolma somaliensis* n. sp.**

Fig. 4a-c

DIAGNOSIS. Shell: Small, very solid, with moderately tall spire, sutures not channelled, very slightly stepped, with coarsely granular sculpture and a single row of very short spines on body whorl. Peripheral angulation weak on body whorl and at suture on spire whorls, so that spines rest on upper shoulder of whorl below. Basal angle very weak, represented by a row of gemmules, sub-spinose. A single, weak, sharply gemmate to scaly cord between peripheral and basal angles. Uppermost cord on shoulder slightly stronger than others, of which there are 5-6 on body whorl; 4-6 gemmate cords on base. Whole surface crowded with fine, strongly prosocline growth lines. Basal callus small, occupying about ¼ of base, rather thick when fully developed, pale yellow, white near columella; not separated by a groove from columella when fully mature but a very indistinct groove present in subadults. Colour pale fawn, with a white zone below sutures, gemmules and spines on periphery and base white, aperture white.

Operculum: Unknown.

DIMENSIONS. Holotype: height 26.04 mm, diameter 23.76 mm; largest paratype: height 28.10 mm, diameter 24.30 mm.

TYPE LOCALITY. Off Somali coast, E. Africa, 11°24'N to 11°29'N, 51°35'E, to 51°36'E, 75-175 m (mostly about 150 m) collected H. E. Vokes.

TYPES. Holotype, USNM, 758386, with 3 paratypes, USNM 758387; 1 paratype in Geol. Dept., Tulane University, New Orleans; 1 paratype in AM, C.106307.

The new species is very similar to the Tasmanian fossil species *B. flindersi*, but differs in its larger size, relatively stronger minor sculpture and in having a more convex base. The base of *B. flindersi* is flat, whereas in *B. somaliensis* it is slightly convex (in immature specimens) to moderately convex (in mature specimens).

B. guttata bathyraphis and *B. guttata guttata* are similar to *B. somaliensis* but differ in being larger, in having a thin, white basal callus, and in having a distinct sutural channel.

***Bolma tamikoana* (Shikama, 1973)**

This species is characterised by its rather weak sculpture, reduced spines, simple sutures, almost complete absence of a peripheral angulation, and the small basal callus which is coloured orange or yellow. Two geographic subspecies are recognised.

***Bolma tamikoana flava* n. sub sp.**

Fig. 13i-k

DIAGNOSIS. Shell: Spire moderately tall; body whorl weakly convex, expanded beyond line of flat spire whorls, with short spines and simple suture. Teleoconch of about 5 whorls, all with numerous, short, hollow spines on periphery, 15 on last two whorls. Body whorl almost evenly convex (peripheral and basal angulations very weak), basal angle marked by a row of gemmules slightly stronger than other basal sculpture on first $\frac{1}{3}$ of body whorl, indistinguishable on remainder of whorl. Sculpture of closely spaced rows of rather coarse gemmules, 12 on shoulder of body whorl, 3 between peripheral and basal angles, about 13 on base, becoming coarser towards columellar region. Basal callus small, occupying approximately $\frac{1}{5}$ of base, thin, transparent. Colour pale lemon-yellow, with regular, rather large, radial, brown blotches on shoulder (6 on body whorl) and a few very small pale brown specks on base; columellar callus bright lemon-yellow behind columella, whitish where spread on base. Outer lip bright lemon-yellow.

Operculum: Oval, white, simple, with weakly wrinkled surface.

DIMENSIONS. Holotype: height 27 mm, diameter (excluding spines) 29 mm, (including spines) 32 mm.

TYPE LOCALITY. 15°24.5'S, 46°02.0'E, off Majunga, N.W. Malagasy Republic, 250-265 m; A. Crosnier Colln.

HOLOTYPE. AMS, C. 112907.

B. tamikoana flava differs from *B. tamikoana tamikoana* in its shorter spire which gives the subspecies a more ovate outline, finer spiral sculpture and a weaker basal angle. The colour patterns of the two subspecies are similar but the basic colour of *B. tamikoana flava* is lemon-yellow whereas in *B. tamikoana tamikoana* it is fawn. The two forms are here recognized as geographic subspecies because of their general morphological similarity, their wide geographic separation and because the observed differences in shell characters are much greater than between widely separated populations of *B. tamikoana tamikoana*.

The new subspecies is known from only one specimen, an adult which was collected alive.

***Bolma tamikoana tamikoana* (Shikama, 1973)**

Fig. 13a-h

Astralium (*Bolma*) *modestum* var. *girgyllus*. — Schepman, 1908: 28 (not of Reeve, 1843).

Astraea tayloriana. — Kuroda & Habe, 1952: 39 (not of E.A. Smith, 1880).

Bolma tayloriana. — Oyama & Takemura, 1960: *Bolma*, fig. 1, 2 (not of Smith).

Galeoastrea tayloriana. — Habe, 1961: 14, pl. 7, fig. 18; Habe, 1964: 21, pl. 7, fig. 18 (not of Smith).

Galeoastrea tayloriana tamikoana Shikama, 1973: 3, pl. 1, fig. 3, 4; Okutani, 1975: 189, pl. 8, fig. 10.

DIAGNOSIS. Shell: Of medium size, spire of medium height to relatively tall, whorls lightly convex, with indistinct sutures and bearing granular spiral cords. Body whorl bi-angled, upper (peripheral) angulation weak, with or without short, hollow spines, 20 small spines on the last whorl of one Japanese specimen, none on another Japanese specimen, and 12 in the only Australian specimen. Spines persistent at suture on early whorls. Spines are narrowly triangular, slightly downwardly directed. Basal angle sharp, with a prominent row of gemmae that are pointed (but not spinose) in the Australian specimen but rounded in Japanese material. Two rows of gemmae between peripheral and basal angles, a weak third in Australian shell; 9-10 closely-packed gemmate spirals on flat base and 7 on side of penultimate whorl, with interstitial spiral threads developing on body whorl of most specimens. Subsutural cord stronger than others on upper whorl surface, situated at base of very narrow, steep subsutural area. Surface of shell between gemmae sculptured with faint, prosocline axial growth lamellae. Basal callus rather thin, spread over about $\frac{1}{3}$ of the base, separated from columella by a groove when immature, a continuous glaze when mature (not fully developed on large Japanese shells examined), bright orange (pale yellowish-white in the dead Australian shell), columella nacreous white. Outer lip very slightly reflected in mature Australian shell, simple in Japanese shells. Surface pinkish-fawn, with pale yellow-brown base; very faint purplish, radial blotches on upper surface.

Operculum: White; almost circular, with a high but slightly concave edge, and convex upper surface; edge concentrically sculptured, upper surface irregularly pustulose.

DIMENSIONS. Holotype: height 33.0 mm, diameter 32.0 mm; paratype: height 33.6 mm, diameter 37.5 mm; figured Japanese specimen: height 34.7 mm, diameter (excluding spines) 33.1 mm; Australian specimen: height 36.3 mm, diameter (excluding spines) 35.5 mm.

TYPE LOCALITY. Off Uotsuri Isle, Senkaku Ids, S.W. Japan, trawled.

TYPE. Holotype, Shikama Colln, Geological Institute, Yokohama National University, with one paratype.

OTHER MATERIAL EXAMINED. Off Torishima Is., Izu Ids, central Japan, 250 m (NSMT) (1); Japan (NSMT) (2); Tosa Bay, Shikoku, Japan (ANSP) (4); Arafura Sea, off Arnhem Land, Northern Territory, Australia, 8°14'S, 133°12'E, 125 m (AM, C.72710) (1); "Siboga" Stn 100, 6°11'N, 120°37.5'E, Indonesia, on dead coral, 450 m (Zoölogisch Museum, Amsterdam), the specimen recorded as *Astralium* (*Bolma*) *modesta* var. *girgyllus* by Schepman (1908).

OTHER LOCALITIES. Stn D86 (L1), 33°22.0'N, 133°39.1' E, 150-190 m, Kurose Bank, off Hachijo Island, Japan (Okutani, 1975).

The Japanese shells loaned to us from the NSMT (fig. 13a-c) and shells figured by Oyama & Takemura (1960, *Bolma*, figs. 1, 2), Habe (1961, pl. 7, fig. 18; 1964, pl. 7, fig. 18) and Shikama (1973, pl. 1, fig. 3, 4) differ from the single specimen from the Arafura Sea (fig. 13g, h) only in having shorter and more numerous peripheral spines. As the peripheral spines of *Bolma* vary greatly between individuals we consider the Japanese and Australian specimens to be conspecific.

Bolma tamikoana tamikoana differs from all other species of *Bolma* in its relatively weak sculpture, reduced spines, almost straight spire outlines, simple sutures, and almost absent peripheral angulation and prominent basal angle. From the South African *B. tayloriana*, with which it has been confused by several Japanese authors, it differs in its taller spire, coarser sculpture, different dorsal coloration, thicker shell, much smaller basal callus, in bearing a row of small peripheral spines, in having a basal angulation, in the different operculum, and in lacking an obvious periostracum.

***Bolma tayloriana* (E.A. Smith, 1880)**
Fig. 14a-h

Turbo (*Pomaulax*?) *taylorianus* E.A. Smith, 1880: 483, pl. 48, fig. 9.

Turbo (*Pomaulax*) *taylorianus*. — G. B. Sowerby 3rd, 1886: 225, pl. 505, fig. 169.

Pachypoma tayloriana. — G.B. Sowerby 3rd, 1897: 18.

Astraea tayloriana. — Bartsch, 1915: 146; Barnard, 1963: 217, figs. 5d, e, 7a, b.

Astralium tayloriana. — Odhner, 1923: 6; Turton, 1932: 176.

DIAGNOSIS. Shell: Broadly conical, of light build, whorls lightly convex, without spines on body whorl, and with simple sutures (except on early spire whorls where there is a sutural channel as described by Barnard (1963, p. 218) and short peripheral spines). Sculpture of fine, closely gemmate spirals. Periphery sharply angled, with 11-16 rows of finely gemmate spiral threads on penultimate and body whorls and 16-18 on base. No basal angulation. Columellar callus yellow, narrow, a thin basal callus spreading over about 1/3 of base, pale yellowish-white, apertural edge of columella white. Outer lip thin, not expanded. Surface pinkish-mauve above, sometimes with brownish axial bands (fig. 14e, f), yellowish-white on base. Periostracum rather thick, brown.

Operculum: Oval, rather pointed at outer end, sharply rounded on columellar end and slightly concave on the edge against the parietal wall; columellar end thick, remainder thin, the central area slightly excavated, smooth; white.

DIMENSIONS. Holotype: height 40 mm, diameter 49 mm; figured specimen: height 39.75 mm, diameter 48.76 mm.

TYPE LOCALITY. Not known.

HOLOTYPE. BMNH, 1879.2.26.229.

OTHER MATERIAL EXAMINED. South Africa: Trawled off Cape Town (AMNH) (2); off Mossel Bay (AMNH) (1); False Bay, Cape of Good Hope, 37 m (SAM) (1); off Cape Columbine, 146 m, 26 April 1962 (NM, F6630); 34°54'S, 19°48'E, 48 m (NM, A3585).

OTHER LOCALITIES. *South Africa*: Port Elizabeth (Sowerby, 1897); Port Alfred (Bartsch, 1915; Turton, 1932); Walker Bay, 44 m (Odhner, 1923); False Bay, Cape of Good Hope, 26-73 m; False Bay, 68 and 95 m; off Cape St. Blaize, 68 m; 33°52'S, 25°43'E, 95 m (Barnard, 1963, p. 219).

The only similar species are *B. midwayensis*, which has markedly coarser granular sculpture and more inflated whorls than *B. tayloriana*, and *B. tamikoana*. Both of these species are of different shape from *B. tayloriana*. The low spire, elongate operculum, and thick periostracum set *B. tayloriana* apart from the other described species of *Bolma*, but the juvenile shell and the radula described by Barnard (1963, p. 217) are typical of *Bolma*.

When E.A. Smith (1880) described *B. tayloriana*, no locality was known for the holotype. Subsequently Sowerby (1897, p. 18) recognised it as a South African shell, and several workers (see above in synonymy) have since recorded South African specimens. Examination of the holotype has shown that it is undoubtedly the species described by Barnard (1963, p. 217) from South Africa.

***Bolma* cf. *tayloriana* (E.A. Smith, 1880).**

Fig. 14i-k

Two large specimens and a fragment are referred to *B. tayloriana* but are atypical in some respects. They resemble typical *B. tayloriana* in their purplish pink, convex upper whorl surfaces, their almost flat bases, their widely spread, smooth, thick, white basal calluses with bright orange edge, their sutural channels on early spire whorls, and their weakly differentiated, granular cord at about a quarter of the height of later whorls, but differ from typical specimens in their markedly taller spires, slightly coarser dorsal and ventral granular sculpture and in bearing relatively large, widely spaced, pointed, hollow, scale-like spines around all lower sutures, remaining prominent to the end of the last whorl of one shell and becoming obsolete over the last quarter whorl of the other. There seems to be little doubt that these are specimens of *B. tayloriana* in which the peripheral spines of early spire whorls remain prominent to the last whorl, rather than dying out after a few whorls.

DIMENSIONS. Figured specimens: height (actual) 78 mm, diameter (excluding spines) 80 mm, diameter (including spines) 85 mm; height 76 mm, diameter (excluding spines) 82 mm, diameter (including spines) 84 mm.

LOCALITIES. Trawled eastern Cape Province (NM, A. 3585) (2); trawled off Durban, 494 m (NM, 9304) (1).

The spinose form of *B. tayloriana* is perhaps geographically isolated and so distinguishable as a subspecies, as the one well localised (juvenile) specimen occurs well north of the range of typical *tayloriana*. The two large specimens are, however, poorly localised and more information is required about the distribution of the two forms before they can be properly assessed.

Subgenus *Senobolma* Okutani, 1964

Senobolma Okutani, 1964: 135. Type species (original designation): *Senobolma venusta* Okutani, 1964, deep water off Japan.

This subgenus contains two Japanese species that differ from *Bolma* (*sensu stricto*) in their very small size (up to only 13 mm), tall spires, and sculpture of smooth spiral cords. Okutani (1964, pl. 8, fig. 1) figured the typical *Astraea* protoconch of *B. (Senobolma) venusta*.

***Bolma (Senobolma) exotica* (Okutani, 1969)**
Fig. 5k,l

Senobolma exotica Okutani, 1969: 138, text-fig. 2, 3.

DIAGNOSIS. Differs from *B. (Senobolma) venusta* in having low, rounded gemmae on the upper three spiral cords of early spire whorls, the gemmae becoming progressively more fused into axial ridges down the shell, so that on the last whorl they form short, rounded, very strongly prosocline ridges.

DIMENSIONS. Holotype: height 12.2 mm, diameter 9.8 mm; paratype: height 12.9 mm, diameter 10.7 mm.

TYPE LOCALITY. 26°46.0'N, 135°22.5'E, 644 km off Cape Shiono-Misaki, Japan, 435 m.

TYPES. Holotype, NSMT, with one paratype.

***Bolma (Senobolma) venusta* (Okutani, 1964)**
Figs 5i, j; 17i, j

Senobolma venusta Okutani, 1964: 135, pl. 8, fig. 1-3; Okutani, 1969: 138, text-fig. 4; Kuroda et al., 1971: 49, pl. 15, fig. 7; Okutani, 1972: 80, fig. 13, 14.

DIAGNOSIS. A small, tall-spined *Bolma* with sculpture of smooth spiral cords on surfaces of whorls, short peripheral spines on early spire whorls only, and with a smooth base. The natural-size coloured illustration by Kuroda et al. (1971, pl. 15, fig. 7) shows the colour to be brownish red, with the aperture and base white.

DIMENSIONS. Holotype: height 13.0 mm, diameter 11.0 mm.

TYPE LOCALITY. 34°02.8'N, 138°54.5'E, Zenisu Bank, S.W. of Kozu Is., Izu Ids, Japan, 140-200 m.

TYPES. Holotype, NSMT, with one paratype.

OTHER LOCALITIES. 98 m, S. of Jagoshima, Sagami Bay, Honshu, Japan (Kuroda et al. 1971, p. 49); seven localities on Zenisu, Hyotanse and Takase Banks, south of the Izu-Shichito Ids, Japan, in 106 to 260 m (Okutani, 1972, p. 80).

RECENT SPECIES OF *BOLMA*

In summary, we list our classification of the world Recent species and subspecies of *Bolma*:

Subgenus *Bolma* Risso, 1826

Bolma rugosa group:

Bolma andersoni (Smith, 1902), South Africa.

aureola (Hedley, 1907), Queensland and northern New South Wales, Australia.

girgylla (Reeve, 1843), Japan to Indonesia.

jacquelineae (Marche-Marchad, 1957), W. Africa.

johnstoni (Odhner, 1923), Angola.

modesta (Reeve, 1842), Japan and China.

rugosa (Linné, 1767), Mediterranean Sea and eastern Atlantic Ocean.

Bolma guttata group:

Bolma bartschi (Dall, 1913), Moluccas to Japan.

guttata bathyraphis (E. A. Smith, 1899), Maldivé Islands to South Africa.

guttata guttata (A. Adams, 1863), Sagami Bay, Japan.

guttata millegranosa (Kuroda & Habe in Habe, 1958), southern Japan and southern Queensland.

guttata subsp.?, Western Australia.

henica (Watson, 1885), West Pacific from Australia to Japan, Fiji, Indonesia and southern Africa.

kermadecensis n. sp., Kermadec Islands, South Pacific.

midwayensis (Habe & Kosuge, 1970), Midway Island, Pacific Ocean.

persica (Dall, 1907), Japan.

sp. ?aff. *persica* (Dall), China Sea.

recens (Dell, 1967), north of New Zealand.

somaliensis n. sp., East Africa.

tamikoana tamikoana (Shikama, 1973), Arafura Sea and southern Japan.

tamikoana flava n. subsp., Malagasy Republic.

tayloriana (E. A. Smith, 1880), South Africa.

Subgenus *Senobolma* Okutani, 1964

Bolma (*Senobolma*) *exotica* (Okutani, 1969), Japan.

venusta (Okutani, 1964), Japan.

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ADDENDUM

Since page proofs have been received descriptions of two new taxa, *Galeoastrea formosana* Shikama, 1977 (*Sci. Rep. Yokohama Natl. Univ.*, 2 (24): 12, pl. 2, figs 6a, b) and *Galeoastrea tamikoe* (sic!) shikamai Habe, 1978 (*Venus*, 53 (5): 46) have been received. Both of these names appear to fall into synonymy. *G. formosana* appears to be, as Habe (1978) points out, a colour form of *B. guttata millegranosa*. *G. tamikoana shikamai* is proposed for the spineless form of *tamikoana* figured as *G. tayloriana* by Habe (1961: 14, pl. 7, fig. 18) which we do not consider to be sufficiently distinct to be recognised as a separate taxon.

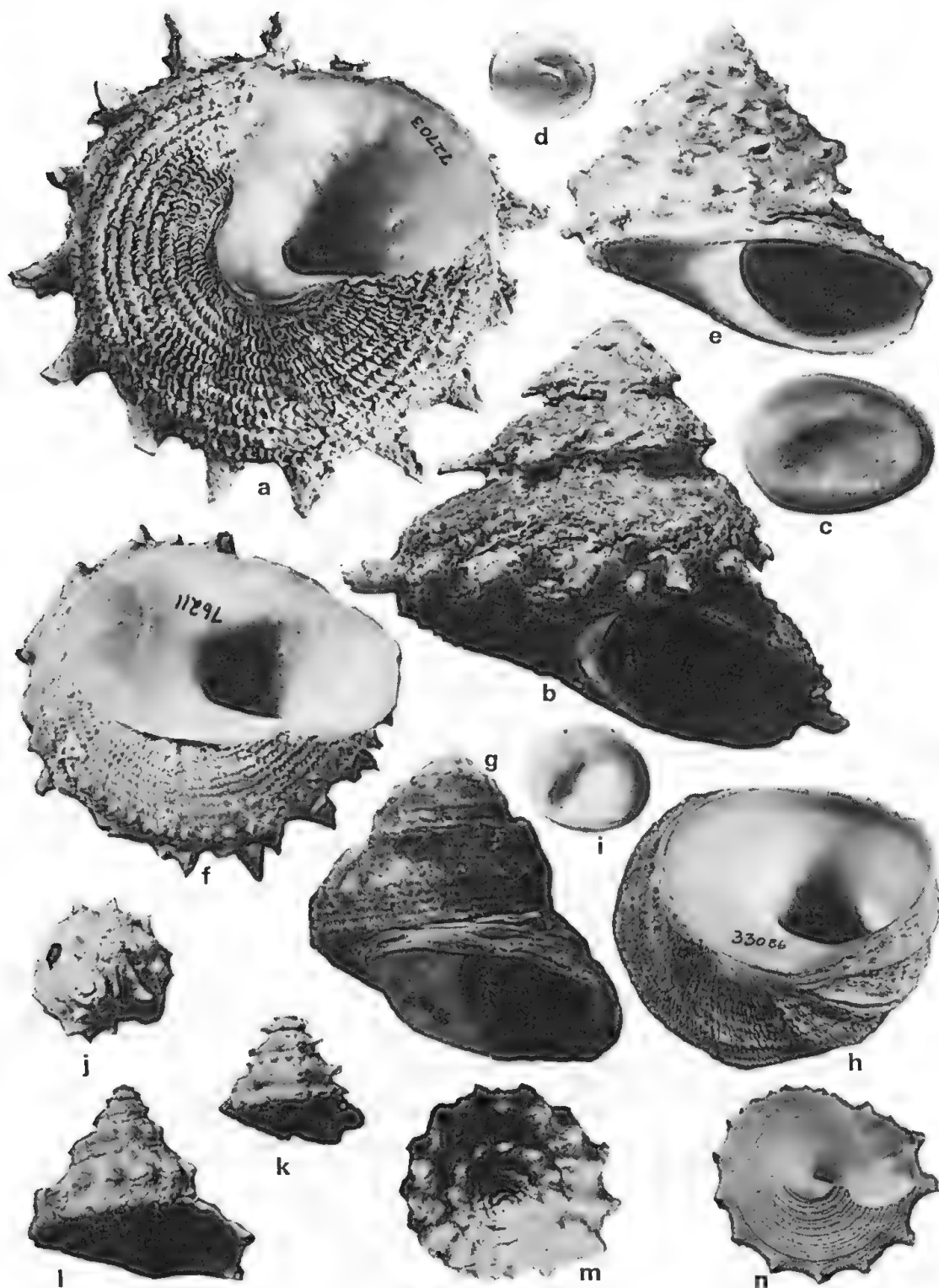


Fig. 1 a-c *Bolma aureola* (Hedley), Off Wide Bay, Queensland, 55 m, AM, C. 72703. Height 62 mm. d-f *Bolma modesta* (Reeve), Japan; AM, C. 76211. Height 50 mm. d, operculum coated with ammonium chloride. g-i. *Bolma rugosa* (Linné), Marseilles, France, Mediterranean Sea; AM, C. 33086. Height 46 mm. j-n. *Bolma andersoni* (Smith); j, k, juvenile, off Durban, South Africa, ex gut loggerhead turtle; NM, A235. Height 12.1 mm; l-n, off Natal; NM, 3729. Height 31.6 mm

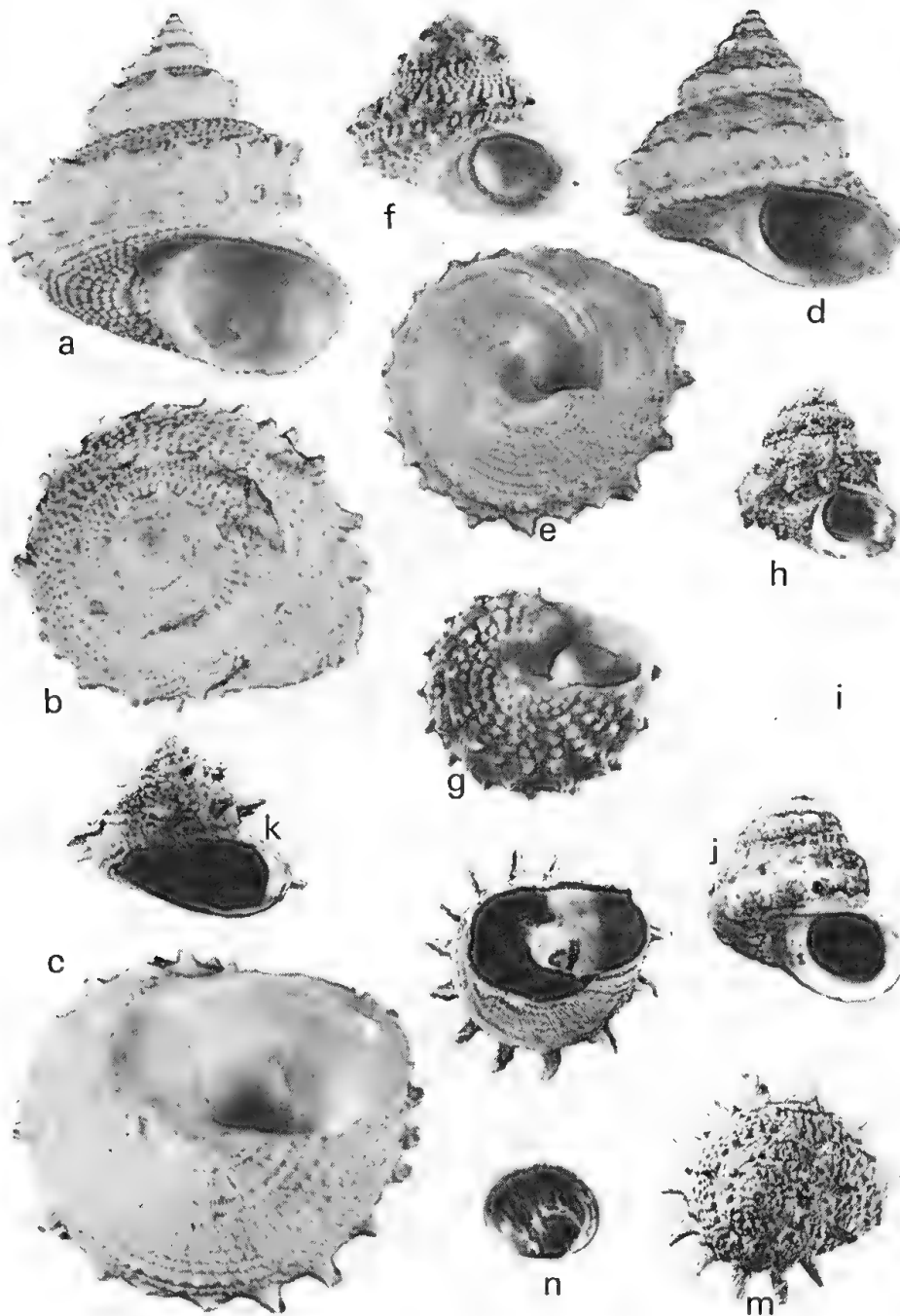


Fig. 2. a-c. *Bolma girgylla* (Reeve), lectotype, "China," H. Cuming Colln.; BMNH, 1968673. Height 57.4 mm. d-e. *Bolma modesta* (Reeve), Japan: BMNH, 19782. Height 45.7 mm. f-j. *Bolma jacquelineae* (Marche-Marchad); f-i, off Tema, Ghana, W. Africa, coll. R. Isaacs, from fisherman, depth probably 37-42 m; f, g, AM, C.92185. Height 23.5 mm; h, i, NMW, 71.39.Z1. Height 28.5 mm.; j, — São Thomé Is., Gulf of Guinea, W. Africa (ex Melville-Tomlin colln.), NMW, 72.2.Z1. Height 36.2 mm. k-n *Bolma johnstoni* (Odhner), holotype, Porto Alexander, Angola, 110 m; Natural History Museum, Stockholm. Dimensions not known. Photos h-n courtesy of S. P. Dance.

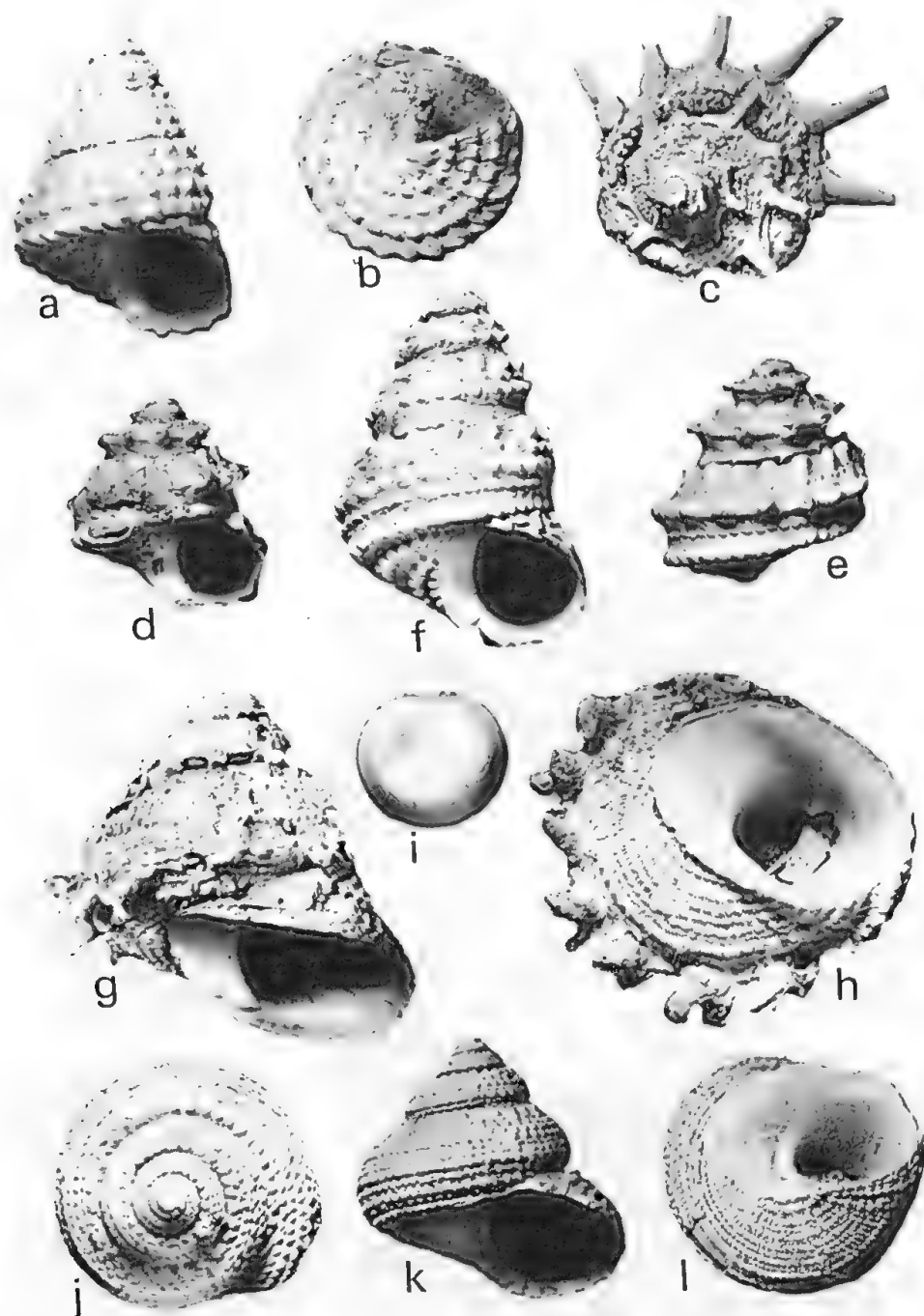


Fig. 3 a-b. *Bolma austroconica* n. sp., holotype, Jan Juc Formation, Bird Rock Cliffs, Torquay, Victoria (Janjukian, Oligocene); NMV, P.31183. Height 15.45 mm. c. *Bolma* aff. *flindersi darraghi* n. subsp., long-spined specimen, Jan Juc Formation, Bird Rock Cliffs, Torquay, Victoria (Janjukian, Oligocene); NZGS WM11, 742. Height 10.5 mm. d-f *Bolma crassigranosa* (T. Woods), Freestone Cove Sandstone, Fossil Bluff, near Wynyard, Tasmania (Longfordian, Lower Miocene). d, e, juvenile resembling holotype of *Astralium ornatissimum* T. Woods; NMV, P.31188. Height 11.8 mm. f, adult; NMV, P.31189. Height 19.5 mm. g-i. *Bolma* ? aff. *persica* (Dall), U.S. Bureau of Fisheries Stn 5311, 161 m, Pratas Is., China Sea; USNM, 237697. Height 27.3 mm. i, operculum coated with ammonium chloride. j-l. *Bolma anacanthos* n. sp. holotype, Jan Juc Formation, ledge, Bird Rock Cliffs, Torquay, Victoria (Janjukian, Oligocene); NMV, P.31183. Height 21.45 mm.

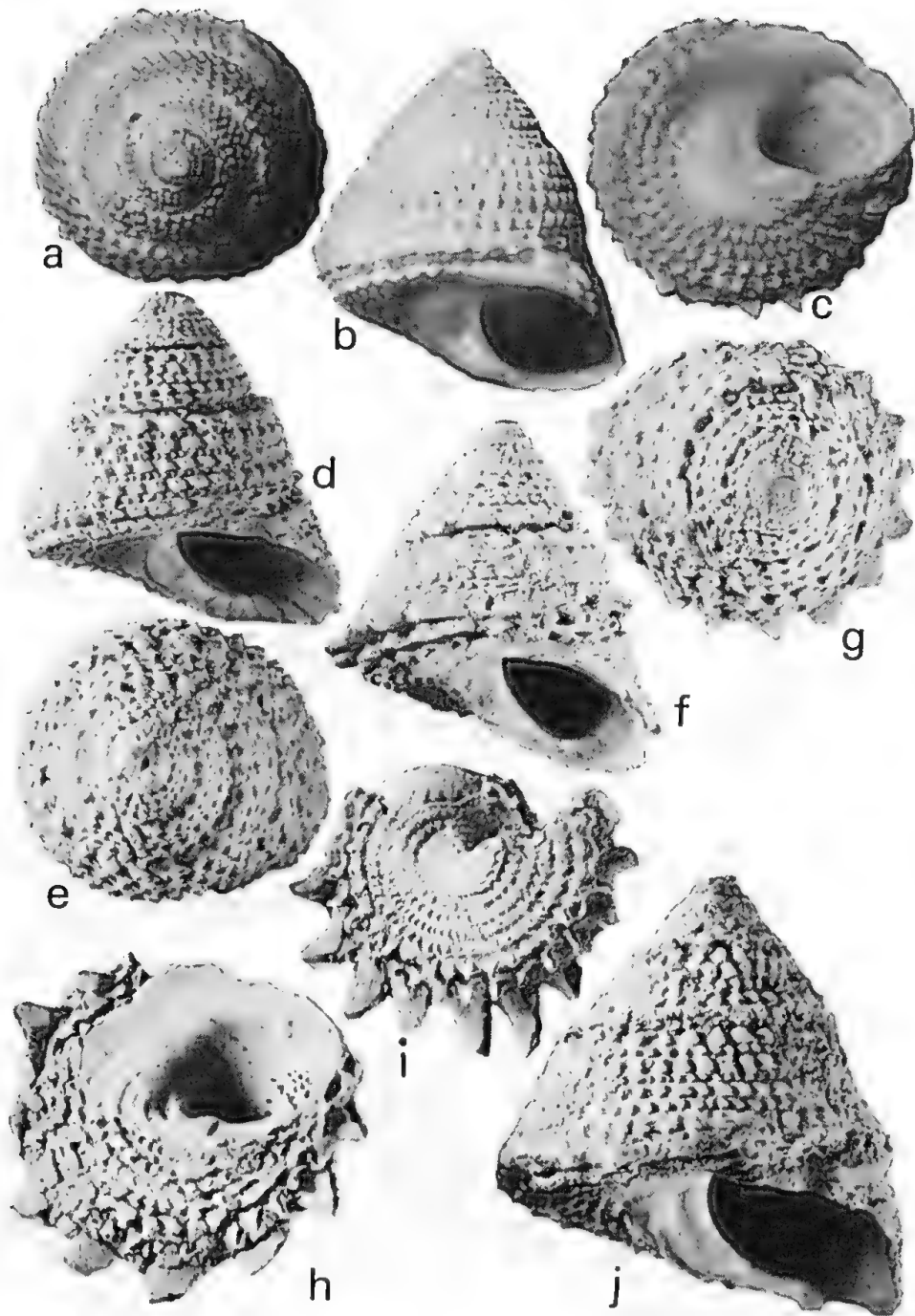


Fig. 4. a-c. *Bolma somaliensis* n. sp., holotype, off Somali Coast, E. Africa, 11°24'N to 11°29'N, 51°35'E, 74-175 m; USNM, 758386. Height 26.04 mm. d-j. *Bolma flindersi flindersi* (T. Woods), Freestone Cove Sandstone, Fossil Bluff, near Wynyard, Tasmania (Longfordian, Lower Miocene); all in NMV. d, e, common form. Height 18.0 mm; f-h, long-spined specimen. Height 17.8 mm; i, extremely long-spined individual. Height 13.8 mm; j, largest specimen seen. Height 21.5 mm.

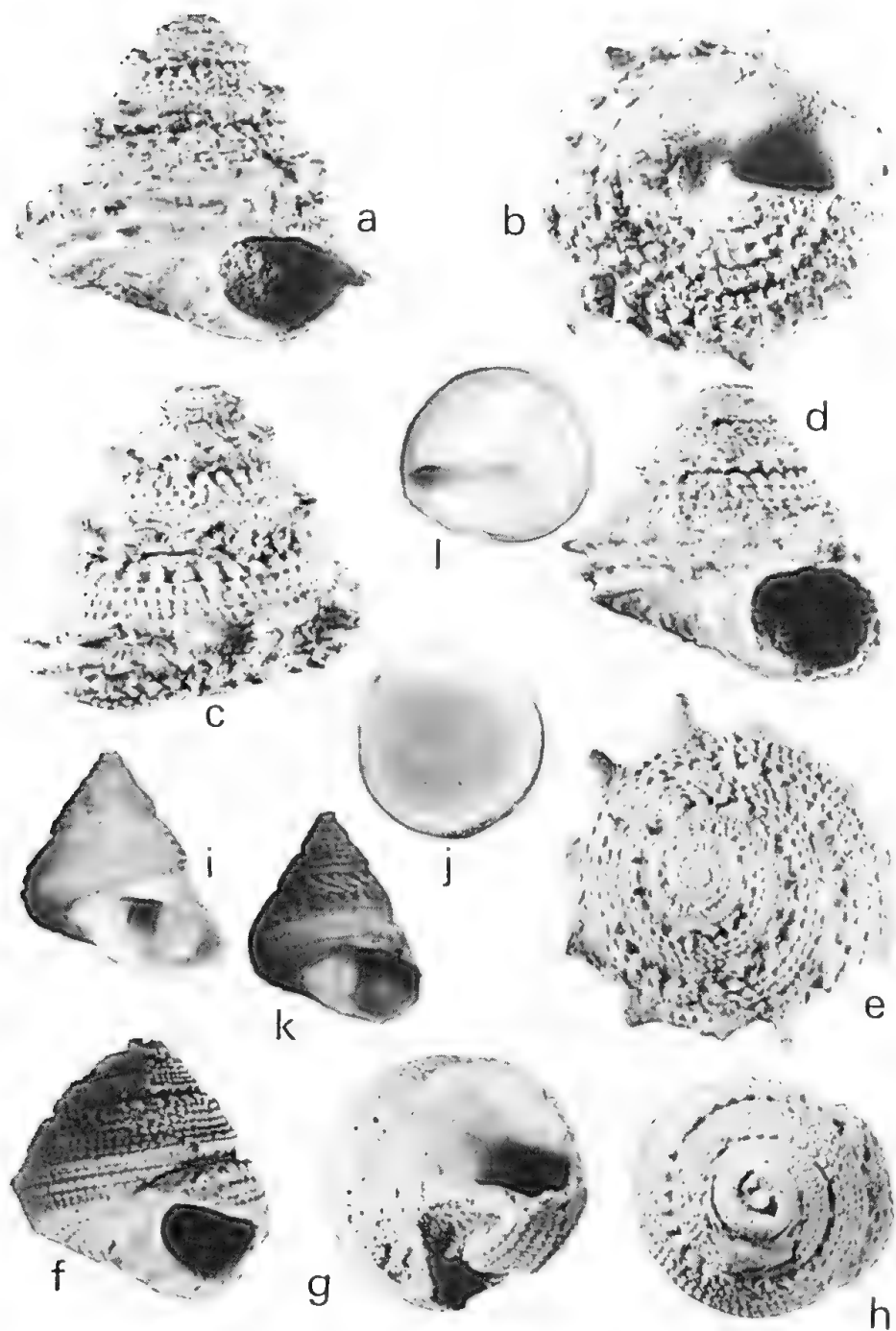


Fig. 5. **a-h.** *Bolma flindersi darraghi* n. subsp., Brown's Creek, Johanna, west of Cape Otway, Victoria, Brown's Creek Clay (Aldingan, Upper Eocene). **a-c**, holotype, NMV, P.30767. Height 13 mm; **d, e**, paratype, NMV, P.30768. Height 11.96 mm; **f-h**, 25 km N. of Walpole along Thomson Highway, W.A. (Aldingan, Upper Eocene); WAM (78-922). Height 11 mm. **i-j**, *Bolma (Senobolma) venusta* (Okutani), holotype, Zenisu Bank, off Izu Ids, Japan, 140-220 m; NSMT, Tokyo. Height 13 mm; **j**, operculum (SEM photo). 34°27.2'N, 139°11.1'E, Takase Bank, off Izu Ids, central Japan, 130 m; Tokai Regional Fisheries Laboratory. **k-l.** *Bolma (Senobolma) exotica* (Okutani), holotype, 26°46.0'N, 135°22.5'E, 644 km off Cape Shiono-misaki, Japan, 435 m; NSMT. Height 12.2 mm.

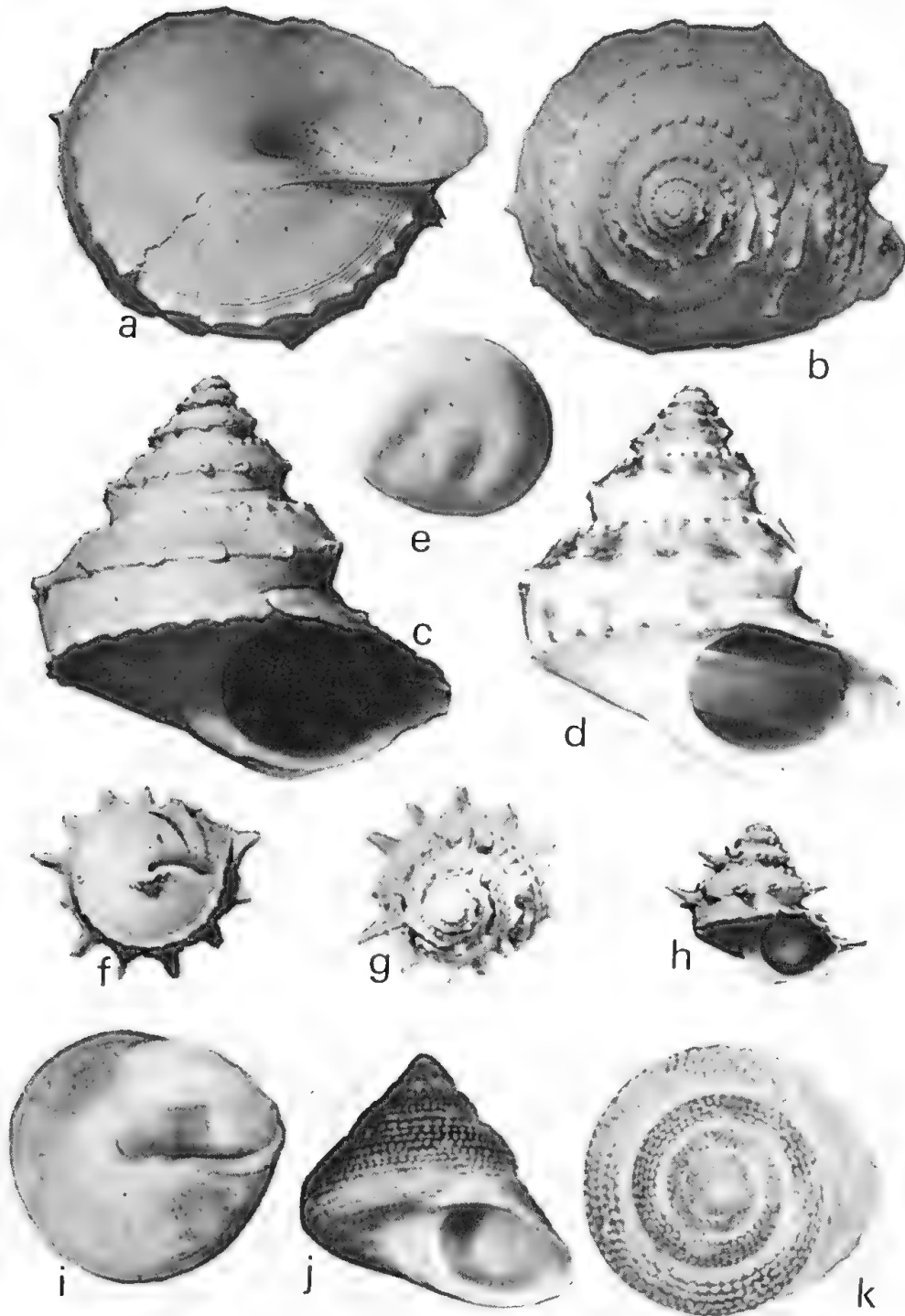


Fig. 6. **a-h.** *Bolma bartschi* Dall, **a-e**, holotype, off Dowarra Is., Molucca Passage, 0°50'S, 128°12'E, 375 m; USNM 214444. Height 30 mm. **a-c**, coated with ammonium chloride; **d**, uncoated, showing colour-pattern; **e**, operculum coated with ammonium chloride; **f-h**, holotype of *Turbo asteriola* Dall, Colnett Strait, Inland Sea of Japan, 251 m; USNM, 205733. Height 14 mm. **i-k.** *Bolma midwayensis* (Habe & Kosuge), holotype, off Midway Is., Pacific Ocean; NSMT. Height 28.6 mm.

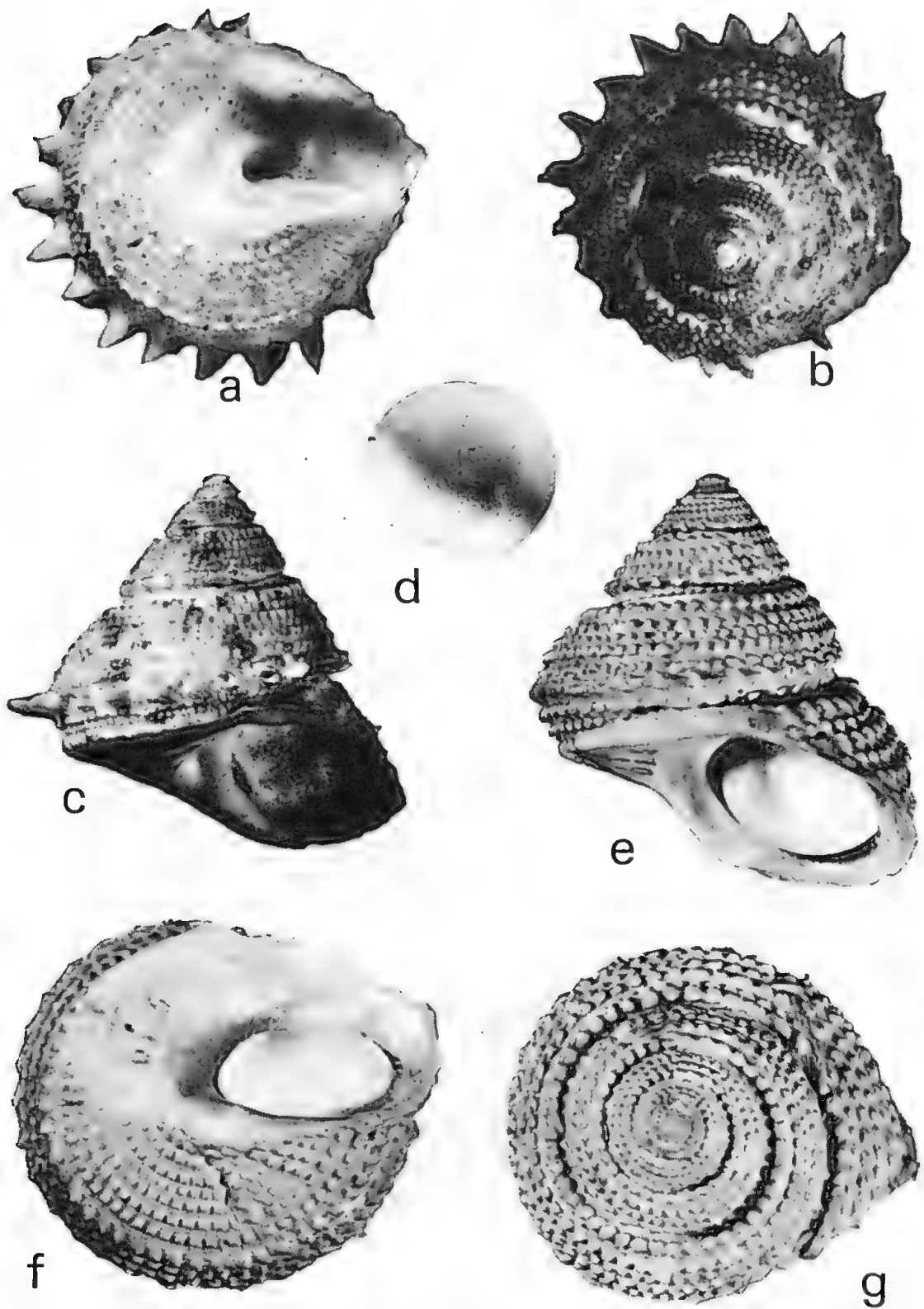


Fig. 7. a-g. *Bolma guttata bathyraphis* (Smith), a-d, holotype of *Astraliu^m gilchristi* Sowerby, 15 km WNW of O'Neil Peak, Natal, 165 m; SAM, A5219. Height 26.9 mm. d, operculum coated with ammonium chloride; e-g, holotype of *Astraliu^m bathyraphe* Smith, Maldiv^e Atoll, 384 m, Zoological Survey of India, Calcutta. Height 34 mm.

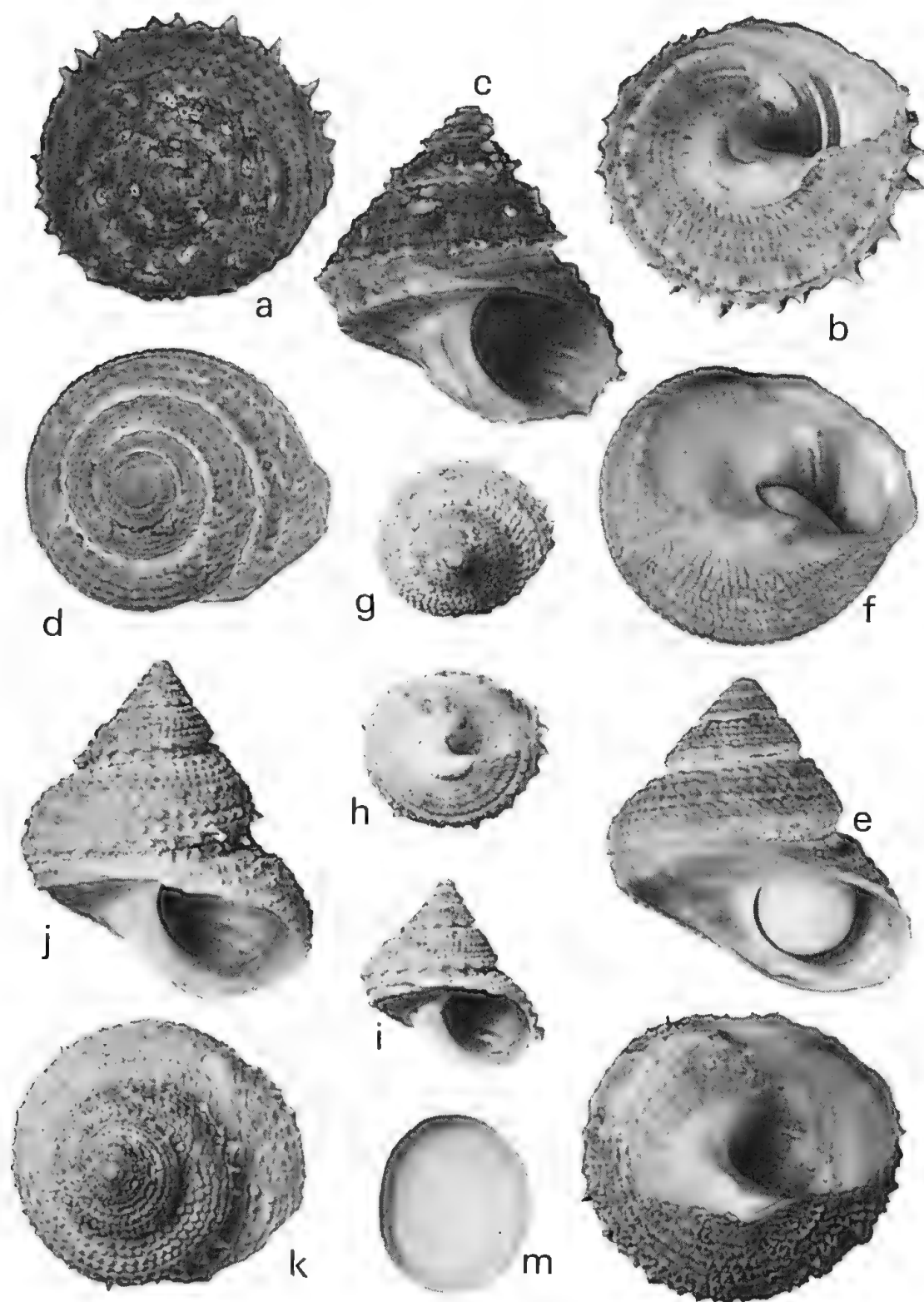


Fig. 8. **a-m.** *Bolma guttata bathyraphis* (Smith), **a-c**, 23°36.3'S, 43°32.5'E, off Tuléar, S.W. Malagasy Republic, 250 m; AMS. Height 29.6 mm; **d-f**, 12°51'S, 48°06.3'E, off Nossi Bé, N.W. Malagasy Republic, 675-705 m; AMS. Height 29.2 mm; **g-m**, 4°43'48"N to 4°44'00"N, 72°55'24"E to 72°54'18"E, Maldive Ids, Indian Ocean, 229 m; BMNH; **g-i**, juvenile. Height 21.1 mm; **j-l**, subadult. Height 38.6 mm; **m**, operculum coated with ammonium chloride.

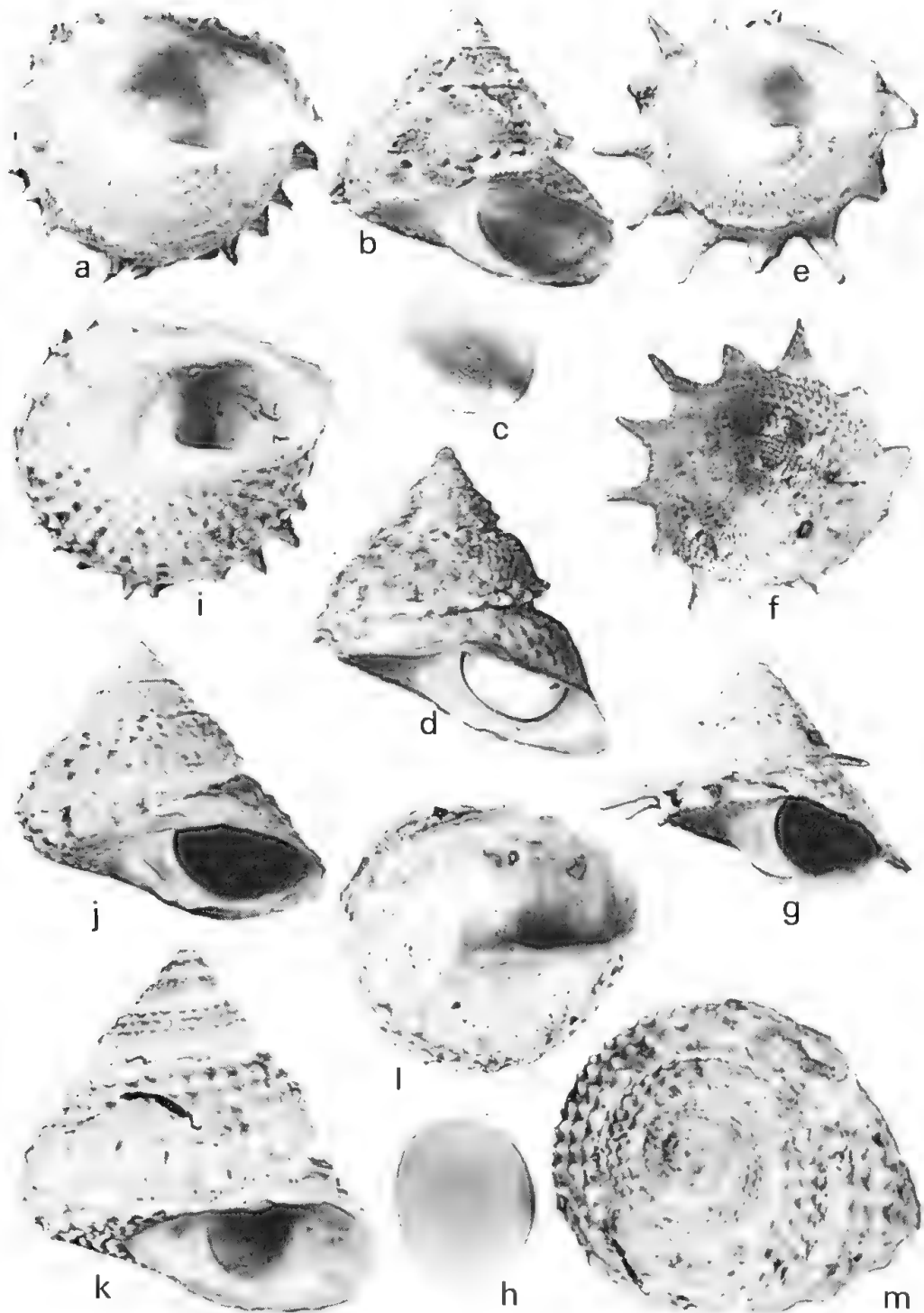


Fig. 9. a-d. *Bolma guttata millegranosa* (Kuroda and Habe), a-c, off Tosa Bay, Shikoku, Japan, 98 m; NSMT. Height 29.5 mm; c, operculum coated with ammonium chloride; d, off Tanabe, Kii, Japan; Thaanum-Langford Colln, Bernice P. Bishop Museum, 10629. Height 41 mm. e-h. *Bolma guttata* subsp.?, between Shark Bay and Onslow, Western Australia; WAM, 1603-70. Height 15.73 mm; operculum uncoated. i-m. *Bolma guttata guttata* (A. Adams), i-j, Okinose Bank, off Sagami Bay, central Honshu, Japan, 48 m; NSMT. Height 31 mm; k-m, presumed holotype, Tateyama, Japan; H. Cuming Colln., BMNH, 1968210. Height 40 mm.

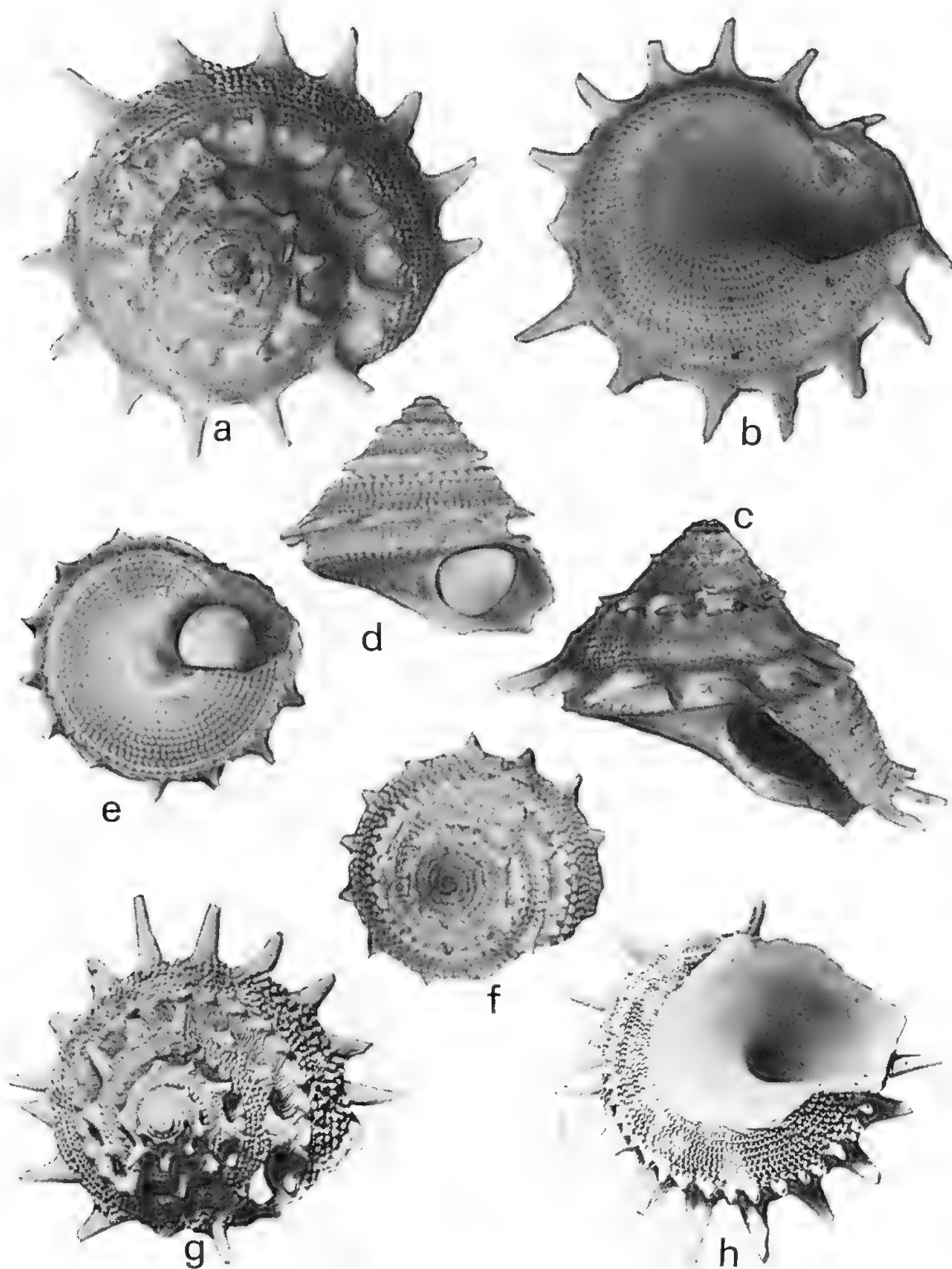


Fig. 10. a-h. *Bolma henica* (Watson), a-c, lectotype (here designated) of *Astraliium* (*Pseudastraliium*) *abyssorum* Schepman, "Siboga" Stn 59, west entrance to Samau Strait, Indonesia, 390 m; Zoölogisch Museum, Amsterdam, 2532. Height 17 mm; d-f, lectotype (here designated) of *Turbo henicus* Watson, "Challenger" Stn 173, off Fiji, 576 m; BMNH, 87.2.9.453. Height 21.6 mm; g-h, the form *gloriosa* Kira, trawled off Tosa Bay, Shikoku, Japan; USNM, 596190. Height 22.9 mm, diameter (including spines) 35.5 mm.

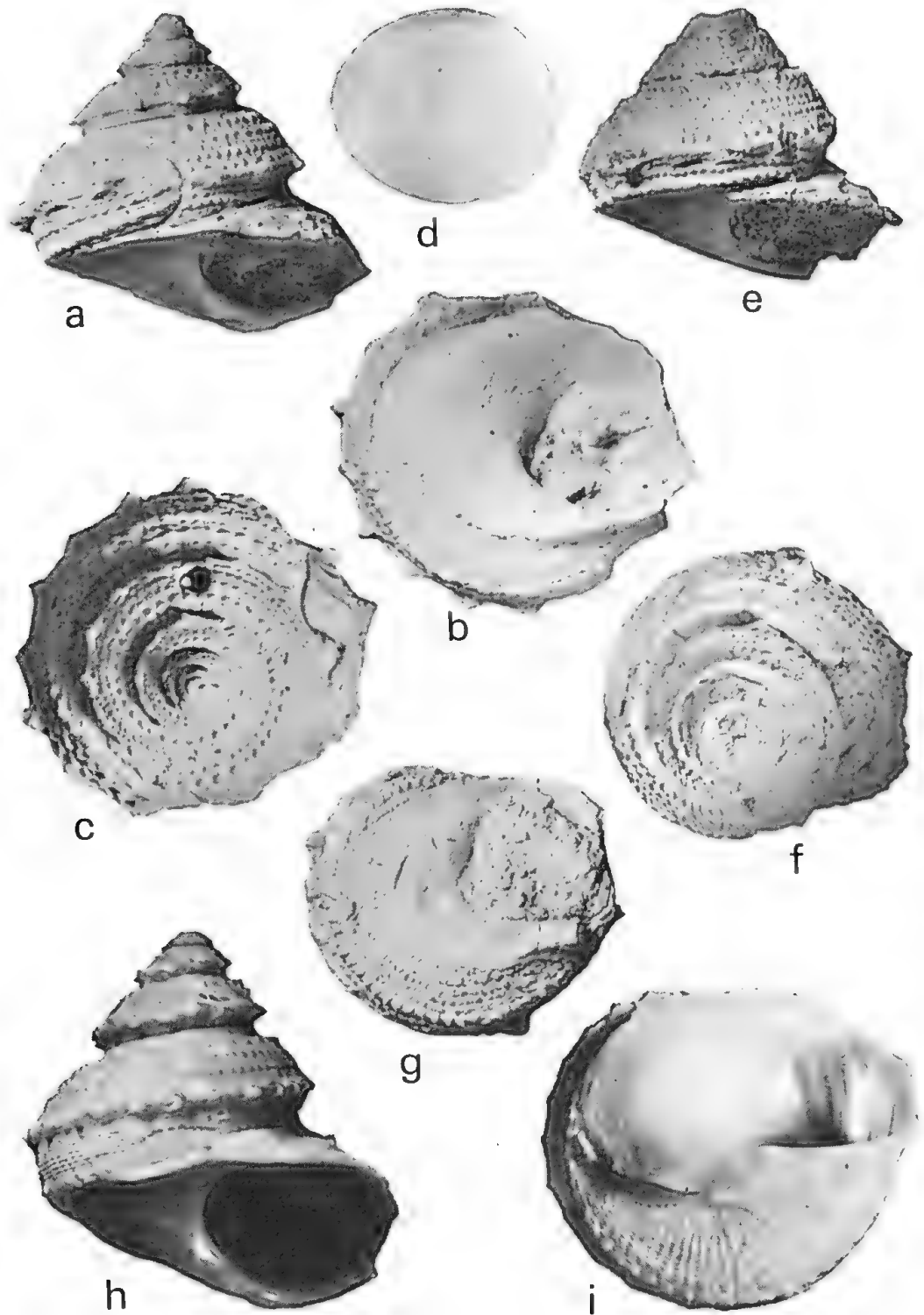


Fig. 11. **a-d** *Bolma marshalli* (Thomson), NZGS locality GS9535, cliffs below Everett's Quarry, south of Oamaru, New Zealand (Whaingaroan, Oligocene); NZGS, TM5421. Height 28.3 mm; **d**, operculum uncoated. **e-g** *Bolma* aff. *marshalli* (Thomson), GS9481, fallen block of Waiareka Volcanic Formation at base of Williams Bluff, Lorne, inland from Oamaru, New Zealand (Kaiatan, Upper Eocene); NZGS, TM5422. Height 22.8 mm. **h-i** *Bolma recens* (Dell), holotype, Kiwi Seamount, between New Zealand and Kermadec Ids, 358-677 m; N.Z. National Museum, M21297. Height 31 mm.

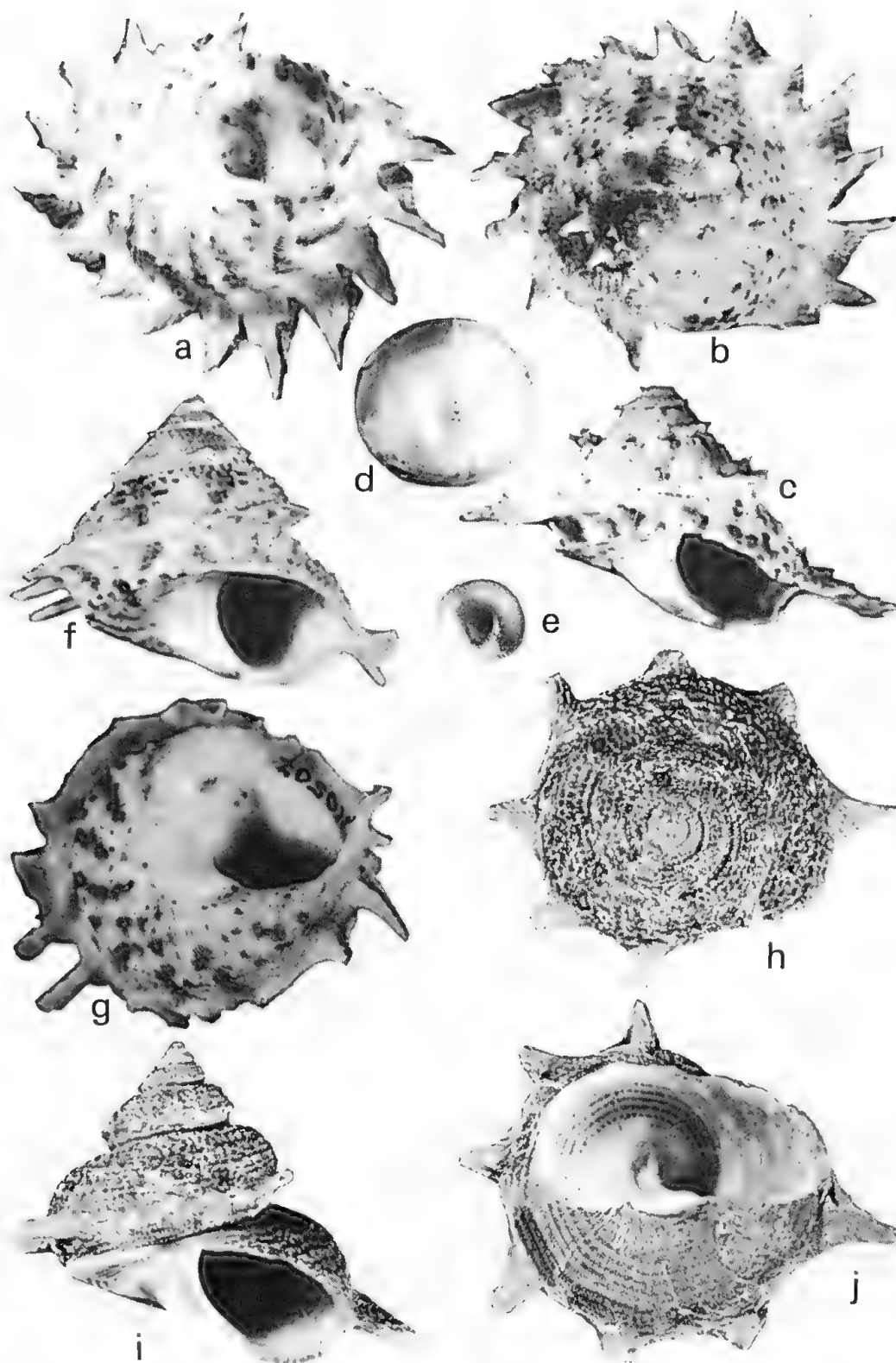


Fig. 12. **a-g.** *Bolma persica* (Dall), off Tosa Bay, Shikoku, Japan, 200 m; NSMT. Height 15.1 mm; **d-e**, operculum; coated with ammonium chloride (**e**); uncoated (**d**); **f-g**, holotype, "Albatross" Stn 4936, 188 m, Kagoshima Gulf, Japan; USNM, 110507. Height 20 mm. **h-j.** *Bolma kermadecensis* n. sp., holotype, east of Curtis Is, Kermadec Ids, 165-135 m; NZOI, H235. Height 36 mm.

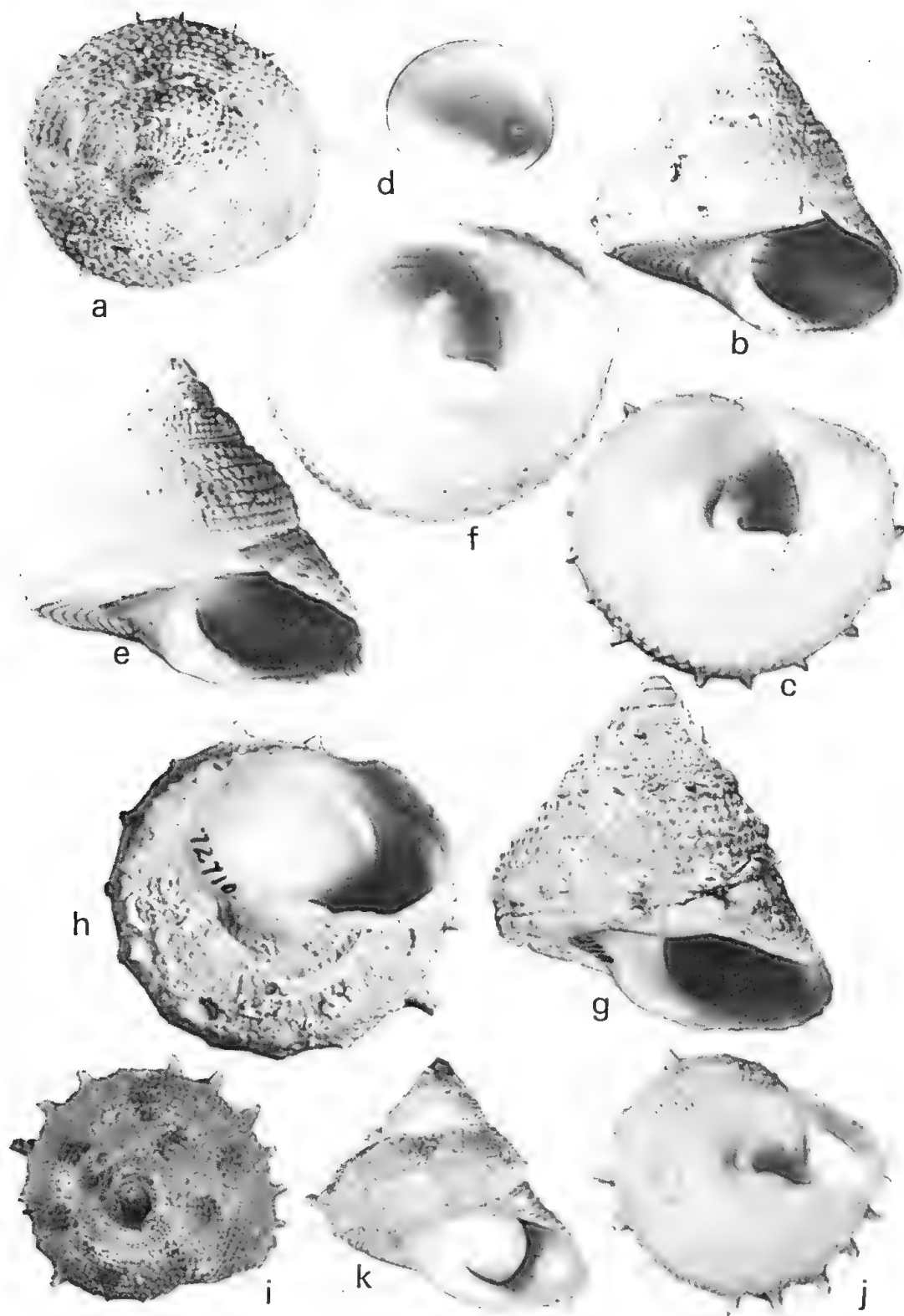


Fig. 13. **a-h.** *Bolma tamikoana tamikoana* (Shikama), **a-c**, off Torishima Is., Izu Ids, central Japan, 250 m; NSMT, 15079. Height 34.7 mm; **d-f**, Japan; NSMT. Height 35 mm; **d**, operculum coated with ammonium chloride; **g-h**, Arafura Sea, off Arnhem Land, Northern Territory, Australia, 125 m; AM, C.72710. Height 36.3 mm. **i-k.** *Bolma tamikoana flava* n. subsp., holotype, 15°24.5'S, 46°02.0'E, off Majunga, N.W. Malagasy Republic, 250-265 m; AMS. Height 27 mm.

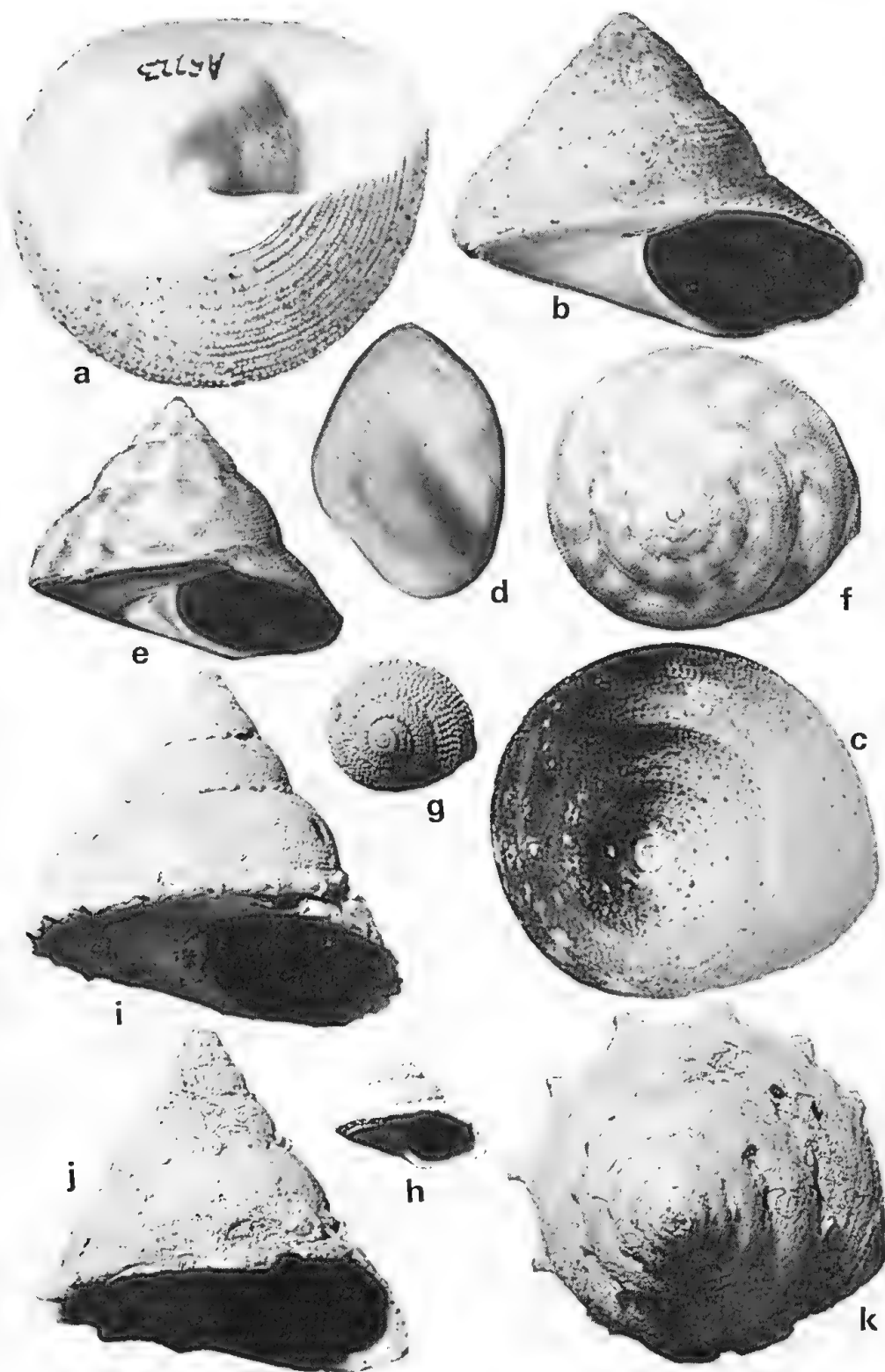


Fig. 14. **a-h.** *Bolma tayloriana* (Smith), **a-c**, False Bay, Cape of Good Hope, 37 m; SAM, A.5223. Height 39.75 mm; **d-f**, axially banded specimen, off Cape Columbine, South Africa, 146 m; NM, F 6330. Height 56.4 mm; **d**, operculum, coated with ammonium chloride; **g-h**, juvenile, 34°54'S, 19°49'E, 48 m, NM, F7284. Height 12.9 mm. **i-k**, *Bolma cf. tayloriana* (Smith), trawled, eastern Cape Province, South Africa; NM, A3585 (2 specimens, **i**, height 76 mm, **j-k**, height 78 mm).

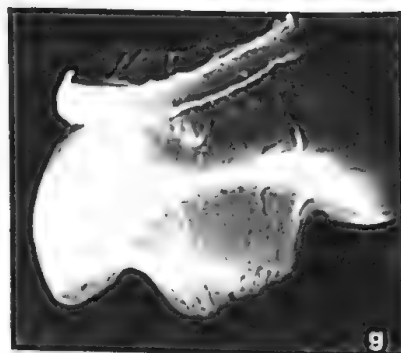
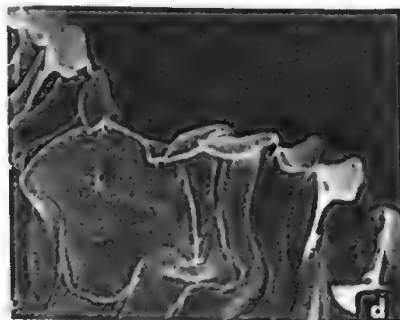
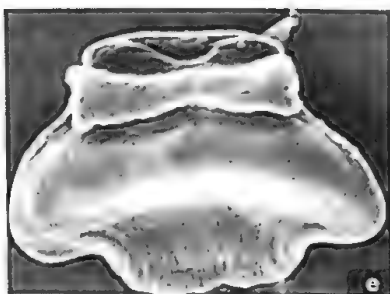
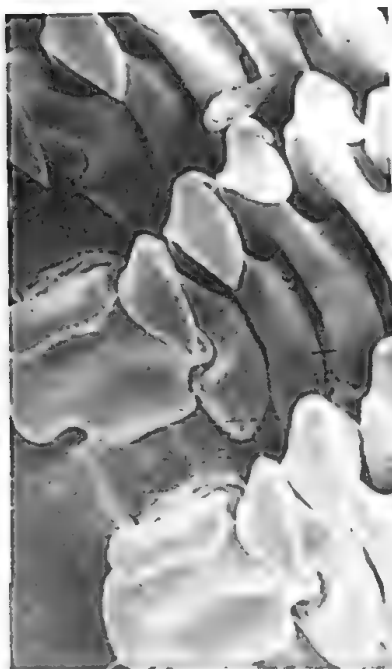
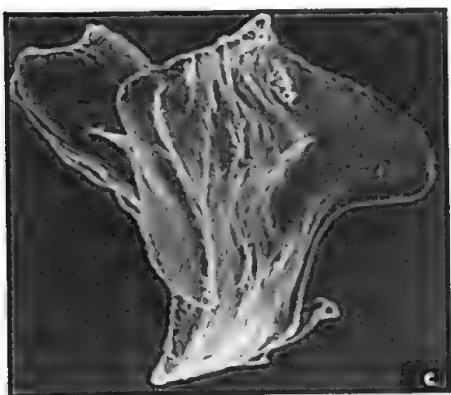
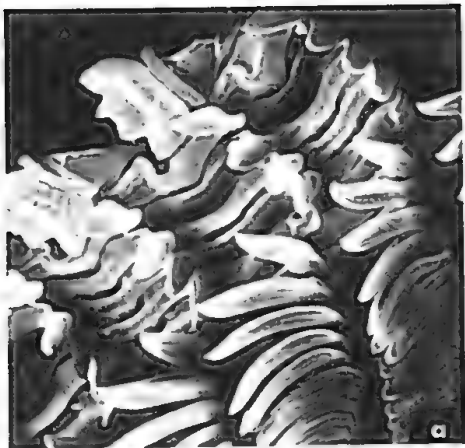


Fig. 15. Radulae of Turbinidae. **a-g.** *Astralium tentoriiforme* (Jonas), Minnie Waters, N.S.W., Australia; AM, C.99730, (SEM stub 84). **a** — central, lateral, and marginal teeth, x 67. **g** — front view of central tooth, x 225. **b.** *Astralium aureus* (Jonas), type species of *Micrastraea* Cotton; Salmon Pt., Elliston Bay, Spencer Gulf, S. Australia, 1 m; AM, C.99773 (SEM stub 81), central, lateral and marginal teeth, X 290. **c-d.** *Astralium kesteveni* (Iredale), type species of *Bellastraea* Iredale; Bare Is., Botany Bay, N.S.W., 3-10 m; AM, C.99774 (SEM stub 159). **c** — partial side view of central tooth, X 340. **d** — central and lateral teeth, X 135. **e-f.** *Astralium calcar* (Linne), type species of *Astralium* Link; Tayabus Bay, W. Quezon Prov., Luzon, Philippines; WAM 684-70 (SEM stub 79). **e** — front view of central tooth, X 340. **f** — lateral and central teeth, X 150 (note: cusp is broken off inner marginal at lower right).

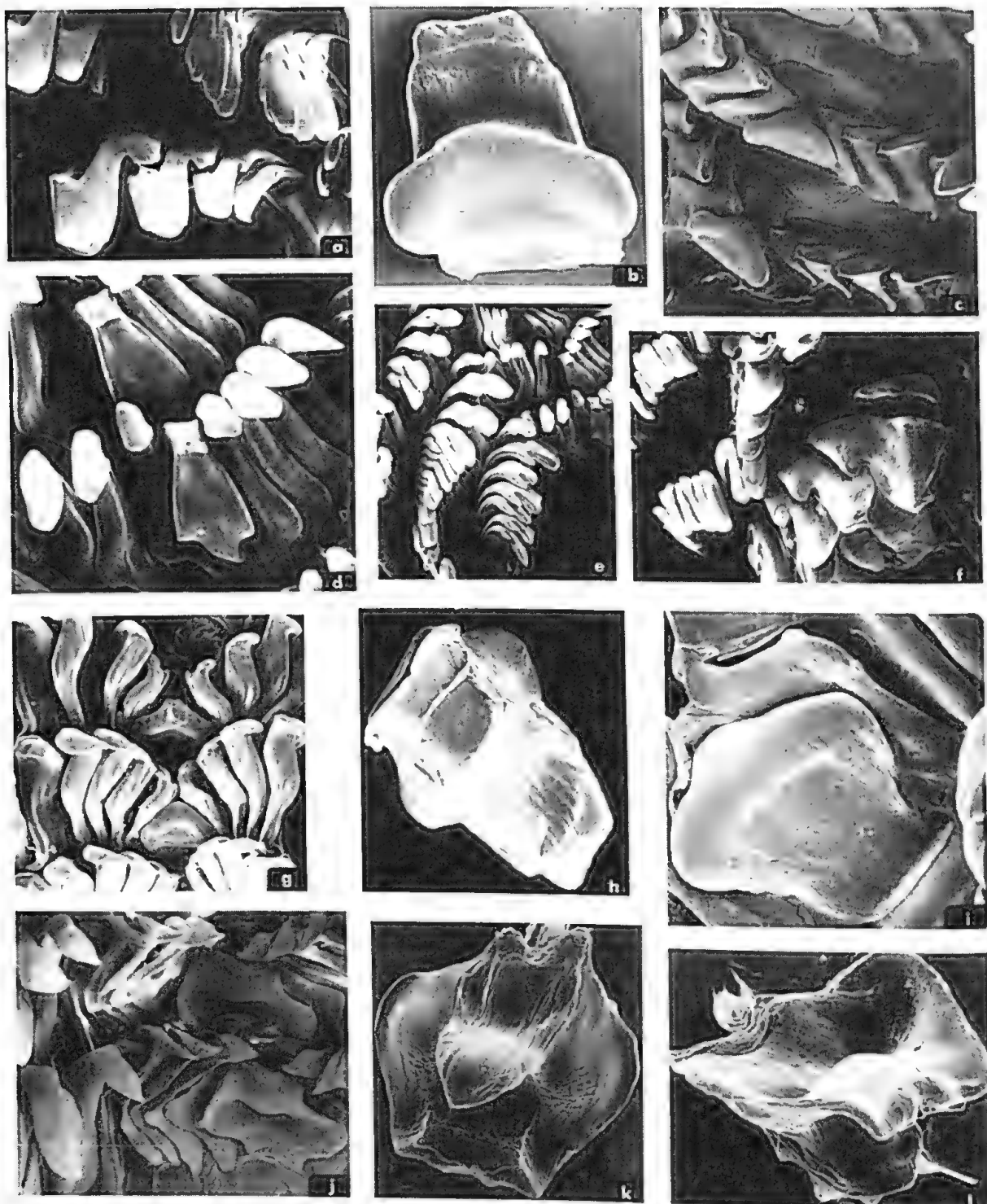


Fig. 16. Radulae of Turbinidae. **a-c.** *Turbo* (*Marmarostoma*) *chrysostomus* Linné, type species of *Marmarostoma* Swainson, Louisiade Archipelago, New Guinea; AM, C.96363 (SEM stub 88). **a** — median marginal tooth, X 150. **b** — front view of central tooth, X 300. **c** — central and lateral teeth, X 65. **d-e.** *Lithopoma tuber* (Linné), type species of *Lithopoma* Gray; Silver Sands, Christchurch, Barbados; AM, C.99728 (SEM stub 92). **d** — central and lateral teeth, X 120. **e** — central, lateral and marginal teeth, X 40. **f-i.** *Lithopoma* (*Cookia*) *sulcata* (Martyn), type species of *Cookia* Lesson; Pauatahanui Harbour, near Wellington, New Zealand; N.Z. National Museum (SEM stub 86). **f** — marginal teeth, X 50. **g** — central and lateral teeth, X 50. **h** — back view of central tooth, X 150. **i** — front view of central tooth, X 150. **j-l.** *Astraea heliotropium* (Martyn), type species of *Astraea* Röding; South Arm, Port Pegasus, Stewart Is., New Zealand; N.Z. National Museum (SEM stub 156). **j** — central, lateral and inner marginal teeth, X 45. **k** — back view of central tooth, X 85. **l** — partial side view of central tooth, X 100.

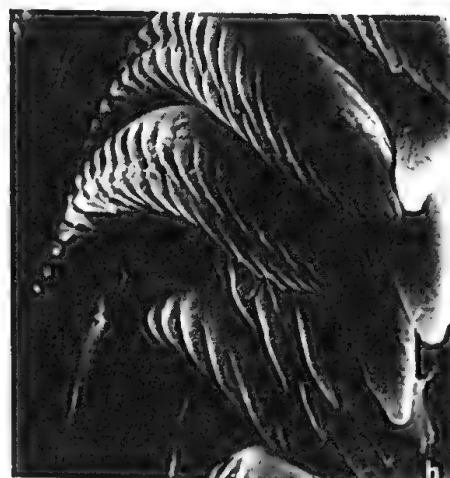
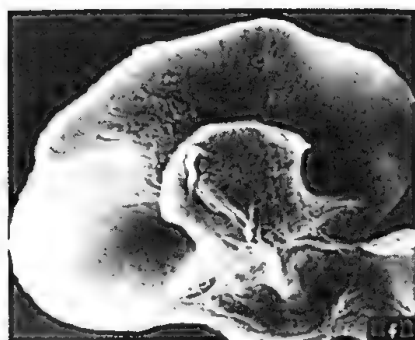
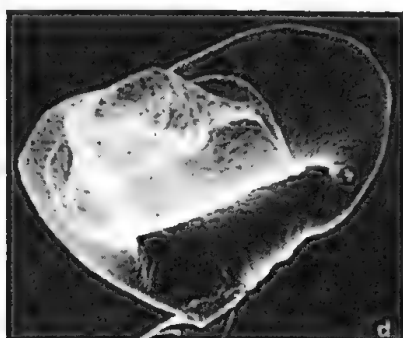
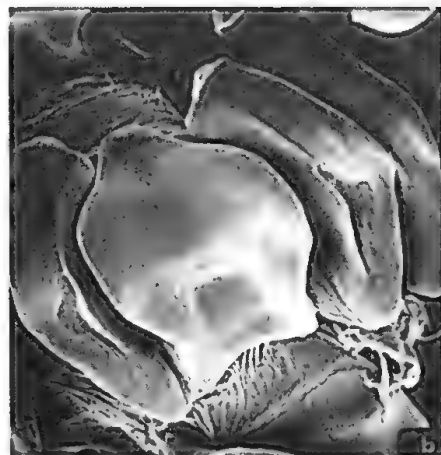
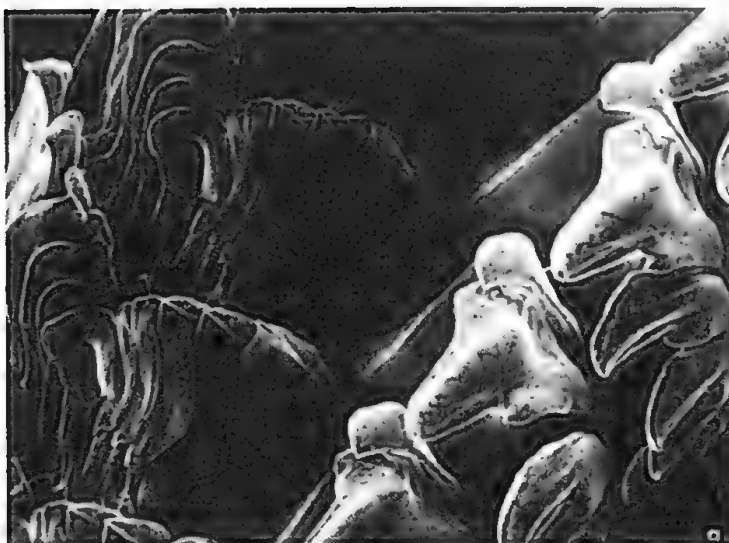


Fig. 17. Radulae of Turbinidae. **a.** *Turbo (Modelia) granosus* Martyn, type species of *Modelia* Gray; Easy Harbour, Stewart Is., New Zealand, 7-18 m; N.Z. National Museum (SEM stub 155); central, lateral and inner marginal teeth, X 80. **b-c.** *Turbo (Ninella) torquatus* Gmelin, type species of *Ninella* Gray; Ulladulla, N.S.W., Australia; AM, C.99732 (SEM stub 93). **b** — central and inner lateral teeth, X 160. **c** — partial side view of central teeth, X 130. **d-e.** *Turbo (Subninella) undulatus* Solander in Lightfoot, type species of *Subninella* Thiele; Ulladulla, N.S.W., Australia; AM, C.99731 (SEM stub 91). **d** — back view of central tooth, X 350. **e** — front view of central tooth, X 380. **f,g,j.** *Guildfordia yoka* (Jousseaume), 7°25'N, 123°14'E, off Philippine Ids, 460 m; Zoological Museum Copenhagen (SEM stub 87). **f** — back view of central tooth, X 600. **g** — median marginal teeth, X 480. **j** — central and lateral teeth, X 320. **h-i.** *Bolma (Senobolma) venusta* (Okutani), type species of *Senobolma* Okutani; 34°27.2'N, 139°11.1'E, Takase Bank, Japan, 130 m; Tokai Regional Fisheries Laboratory (SEM stub 83). **i** — median marginal teeth, X 370. **h** — central and lateral teeth, X 1200.

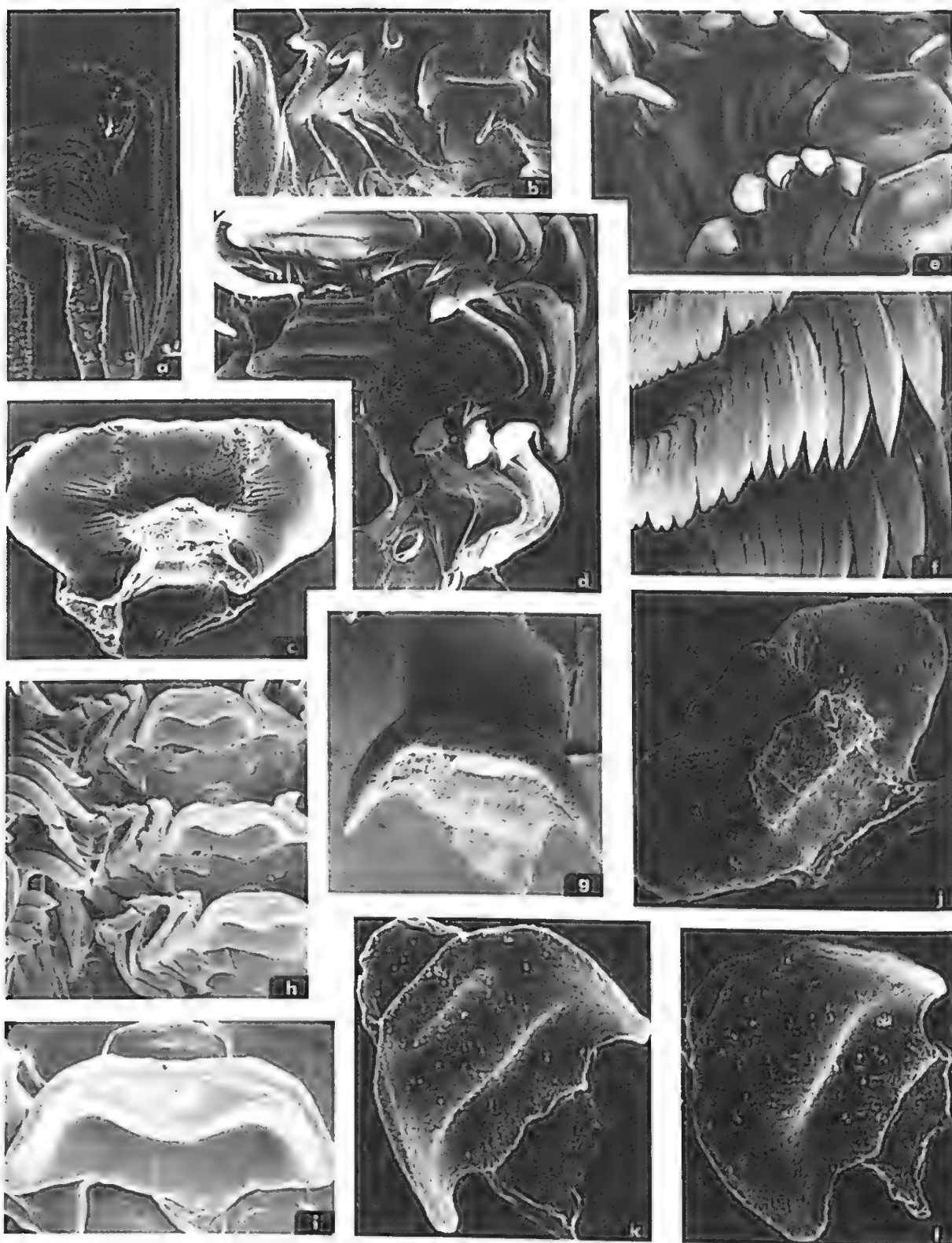


Fig. 18. Radulae of *Bolma*. **a-b, j-l.** *Bolma rugosa* (Linné), type species of *Bolma* Risso; Mediterranean Sea (Zoological Museum, Copenhagen) (SEM stub 72). **a** — median marginal teeth, X 170. **b** — central and lateral teeth, X 110. **j** — back view of central tooth, X 190. **k, l** — front views of central teeth in slightly different orientations, X 190. **c-d.** *Bolma modesta* (Reeve), type species of *Hirasazaea* Habe; W. of Amami-Oshima Is., East China Sea, 25°52.6'N, 125°34.8'E, 109 m Tokai Regional Fisheries Lab. (SEM stub 89). **c** — back view of central tooth, X 160. **d** — central and lateral teeth, X 90. **e-g.** *Bolma jacquelineae* (Marche-Marchad), off Tema, Ghana; AM, C.99729 (SEM stub 5). **e** — central and lateral teeth, X 200. **f** — marginal teeth, X 200. **g** — top view of central tooth, X 380. **h-i.** *Bolma aureola* (Hedley), off Double Island Pt., Tin Can Bay Queensland, 46-55 m; AM, C.99742 (SEM stub 74). **h** — central, lateral and inner marginal teeth (some inner marginal teeth have broken cusps) X 55. **i** — central tooth, tilted forward (X 155).

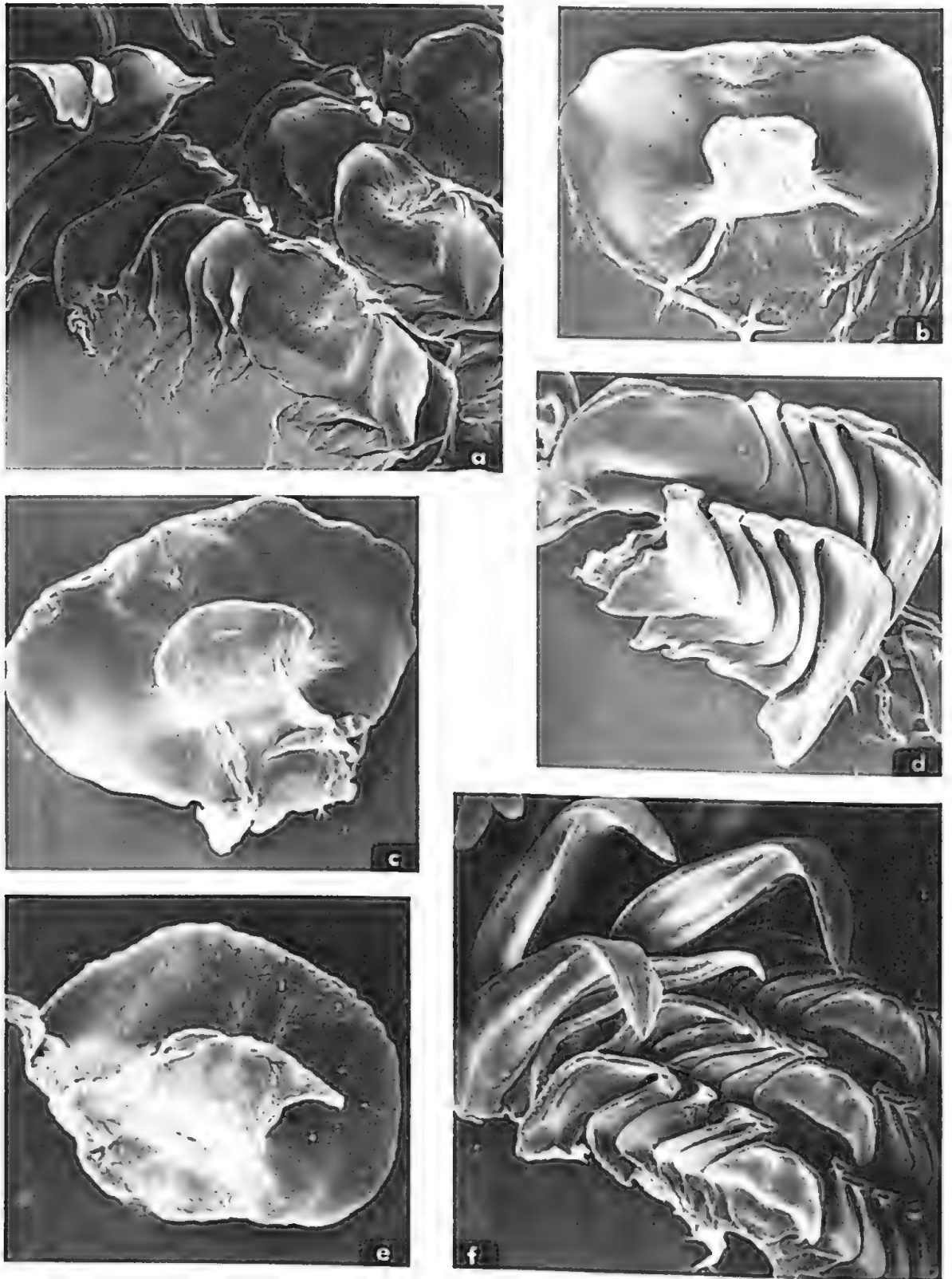


Fig. 19. Radulae of *Bolma*. **a-b.** *Bolma henica* (Watson), type species of *Pseudastrium* Schepman; 5°46'30"S, 132°51'E, S.W. of West Irian, 348 m; Zoological Museum, Copenhagen (SEM stub 85). **a** — central, lateral and inner marginal teeth, X 210. **b** — ventral view of central tooth, X 430. **c-d.** *Bolma guttata bathyraphis* (Smith), Maldive Ids, Indian Ocean, 229 m; BMNH (SEM stub 70). **c** — back view of central tooth, X 320. **d** — central and lateral teeth, X 160. **e-f.** *Bolma guttata guttata* (A. Adams), 34°26'N, 139°11'E, Takase Bank, Japan, 95 m; Tokai Regional fisheries Lab. (SEM stub 73). **e** — back view of central tooth, X 290. **f** — central, lateral and inner marginal teeth, X 100.

**ONYCOCARIS ANOMALA SP. NOV.,
A NEW PONTONIINE SHRIMP
FROM THE NORTHERN TERRITORY,
AUSTRALIA.**

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SUMMARY

A new species of pontoniine shrimp, *Onycocaris anomala* sp. nov., from Port Darwin, Australia, is described and illustrated. The specimens are incomplete but the morphological features of systematic value can be discerned. The specimens, probably associates of sponges, are most closely related to the incompletely known *Typton dentatus* Fujino and Miyake, particularly on account of the characteristic morphology of the endites of the maxilla and first maxilliped, and it is considered probable that further material of *T. dentatus* may indicate that a new genus is necessary for the inclusion of these two species, which are atypical of both *Onycocaris* Nobili and *Typton* Costa, as at present defined.

INTRODUCTION

Through the kindness of Ms. D.E. Brown, it has been possible to examine some pontoniine shrimps from the collections of the Australian Museum, collected in 1929 by A.A. Livingstone from Port Darwin. The detailed examination of these specimens presented several features of unusual interest, preventing an easy assessment of their generic position. The specimens show features found in aberrant species of the genera *Onycocaris* Nobili and *Typton* Costa, both associates of sponges. Typical species of these genera present no problems in identification. In 1969 Fujino and Miyake described *Typton dentatus* from the Ryukyu Islands. This species shows marked resemblances to the present specimens, particularly in the form of the mouthparts, which are atypical for both the genera *Onycocaris* and *Typton*. The two specimens of *T. dentatus* were unfortunately incomplete, and lacked all second pereopods. The second pereopods of the Darwin specimens show some features that are not known in previously described species of *Onycocaris* but are found in some species of *Typton*.

SYSTEMATICS

***Onycocaris anomala* sp. nov.**

MATERIAL EXAMINED. (i) 2 ovigerous ♀♀, between North and South Shell Islands, Port Darwin, Northern Australia, dredged 3-7 fms, 15 July 1929, coll. A. A. Livingstone. AM reg. no. P. 24994.

(ii) 1 ovigerous ♀, as above. AM reg. no. P. 24993.

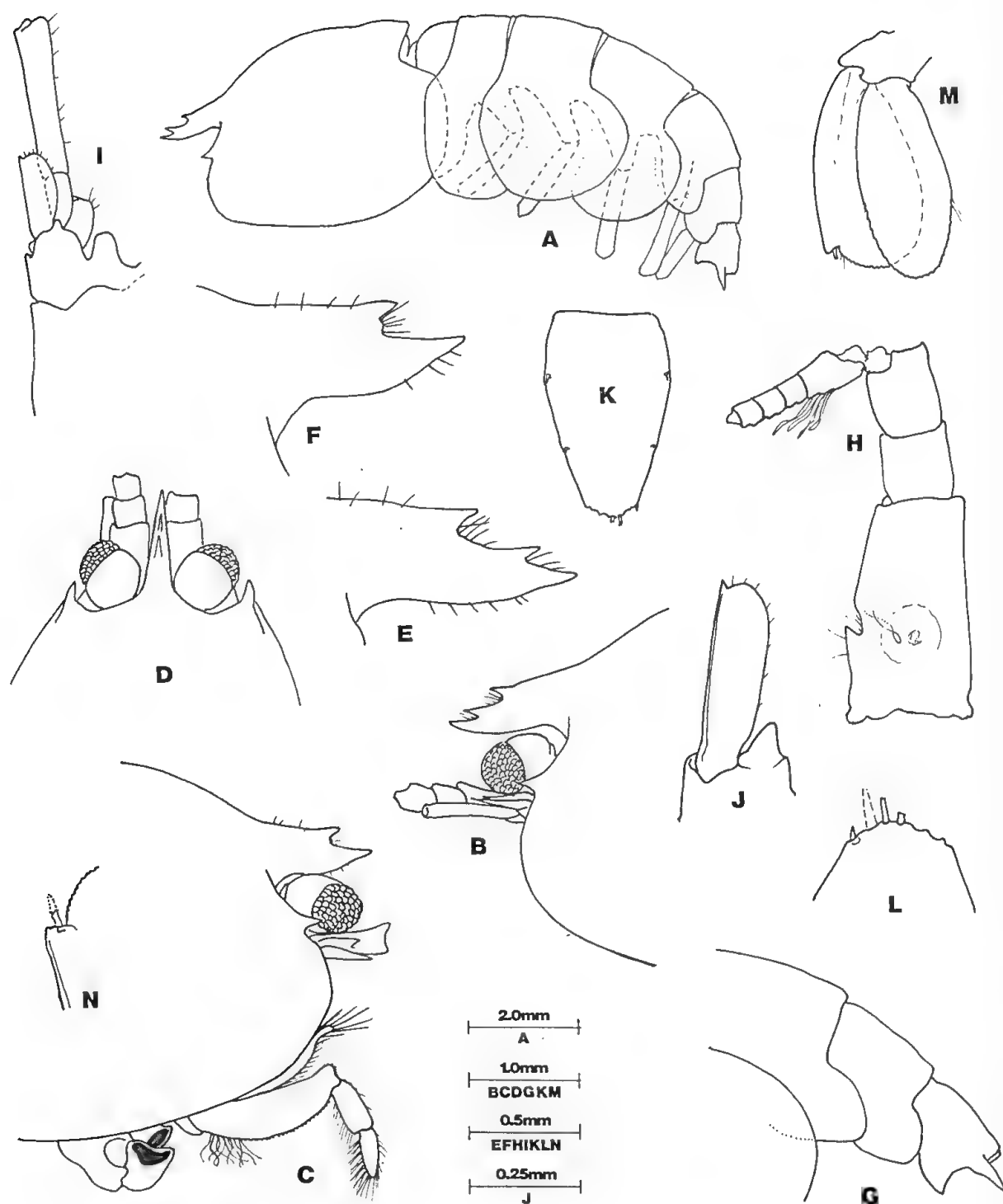


Fig. 1. *Onycocaris anomala* sp. nov. Ovigerous female. A, carapace and abdomen. B, anterior carapace and antennal peduncles. C, anterior carapace, third maxilliped. D, anterior carapace and antennal peduncles, dorsal. E, rostrum. F, rostrum. G, posterior abdomen. H, antennule. I, antenna. J, scaphocerite. K, telson. L, posterior telson spines. M, uropod. N, disto-lateral angle of exopod of uropod. A-B, D-E, G, holotype; C, F, H-N paratypes.

DESCRIPTION. Small, robust, stout bodied pontoniine shrimps, with subcylindrical body form. The carapace is smooth and presents a slightly tumid appearance. The rostrum is short, and moderately depressed, extending to the proximal border of the distal segment of the antennular peduncle. The rostrum tapers distally to an acute tip, with feebly developed lateral carinae. The dorsal margin bears one or two acute teeth on its distal half and the ventral margin is feebly convex and without teeth. Supra-orbital, hepatic and epigastric spines are lacking. The orbit is feebly developed, but an acute

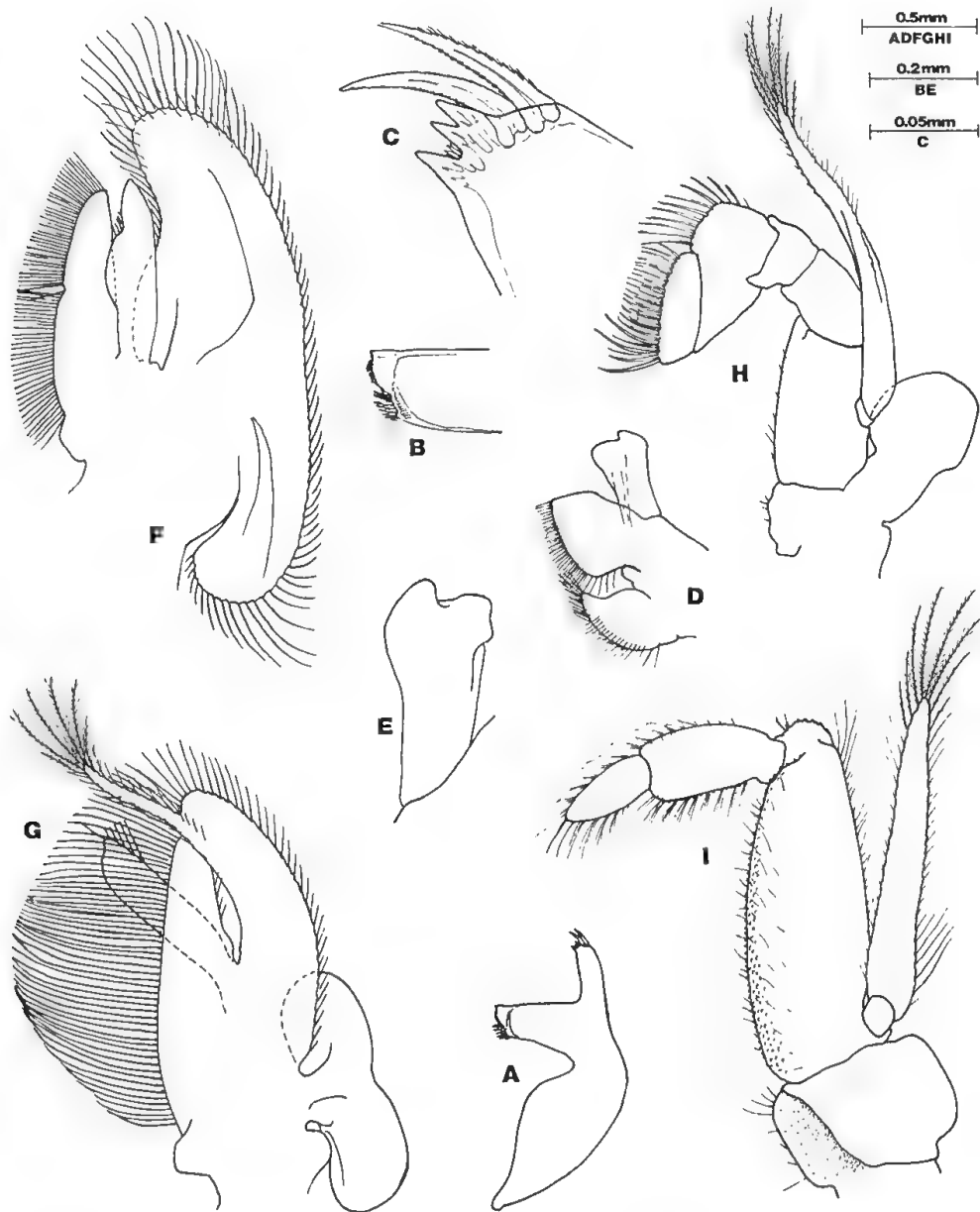


Fig. 2. *Onycocaris anomala* sp. nov. Holotype: A, first pereopod. B, chela of first pereopod. Paratype: C, major second pereopod. D, fingers of major chela, medial aspect. E, fixed finger, distal ventral aspect. F, minor chela. G, fingers of minor chela, lateral aspect. H, fingers of minor chela, medial aspect. Holotype: I, third pereopod. J, propod and dactyl of third pereopod. K, propod and dactyl of fifth pereopod.

tooth lies over the lateral aspect of the eye, slightly above the level of the basicerite. The inferior orbital angle is obsolete. The antero-lateral angle of the branchiostegite is broadly rounded and slightly produced anteriorly. The posterior margin of the branchiostegite is also broadly rounded.

The abdominal segments are smooth. The third tergite is not produced posteriorly. The fifth segment is about as long as the sixth, which is about 1.3 times longer than deep. The postero-lateral angle is long, slender and acute and the postero-ventral angle is large, broad and acute. The pleura of the first three segments are greatly enlarged and rounded. The fourth and fifth pleura are smaller, of almost similar size and also rounded.

The telson is about twice the length of the sixth abdominal segment, broad, about 1.6 times longer than wide, with the greatest width at about one third of the length. The lateral borders are strongly convex, and the width of the posterior margin is a little more than half the width of the anterior border. Two pairs of very small submarginal dorsal spines are present at approximately 0.33 and 0.66 of the telson length. The posterior margin is broadly rounded, without a median point, with three pairs of posterior spines most of which are lost. The lateral spines are very small, similar to the dorsal spines. The intermediate spines are short and stout, equal to about 0.14 of the telson length. The submedian spines are slender, but no complete ones are preserved.

The eyes are well developed, with a hemispherical cornea. The podophthalmite is short and stout, slightly wider than the diameter of the cornea. No accessory pigment spot is discernible.

The antennulae are short and small. The antennular peduncle exceeds the tip of the rostrum by the distal segment. The proximal segment is about 1.7 times longer than wide, with the distal half of the lateral border straight, convergent, to an unarmed disto-lateral angle. The stylocerite is greatly reduced and is represented by a short stout acute process. The statocyst is normally developed with a small statolith. The intermediate segment is slightly longer than wide, about one third of the length of the proximal segment. The distal segment is about 1.3 times the length of the intermediate segment and subequal in width. The flagella are all damaged or missing.

The antenna has a short stout basicerite, unarmed laterally, with a large protuberant aperture for the maxillary gland medially. The ischiocerite and merocerite are normal. The carpocerite is long and slender, reaching to the proximal border of the distal segment of the antennular peduncle, about 4.5 times longer than wide. The flagella are lacking. The scaphocerite is greatly reduced, equal to about half the length of the carpocerite and reaching to about 0.15 of its length. The lamina is about 3.2 times longer than wide, with a straight lateral margin bearing a small acute tooth distally. The anterior margin is rounded, and scarcely exceeds the tip of the disto-lateral spine. The anterior and medial margins are only feebly setose.

The mandible has a robust corpus and is without a palp. The molar process is stout, tapering slightly distally, with a truncated distal end, with large blunt teeth anteriorly and some short setae posteriorly. The incisor process is rather feeble, with three small acute teeth distally. Some small spinules are present between the medial and intermediate teeth. On the disto-lateral extremity two large setulose spines are present.

The maxillula has a short blunt bilobed palp, with the stouter medial lobe devoid of setae. The upper lacinia is short and broad, with numerous short setae forming a fringe along the medial border. The lower lacinia is robust, distally pointed, also with a fringe of short setae along its lower border.

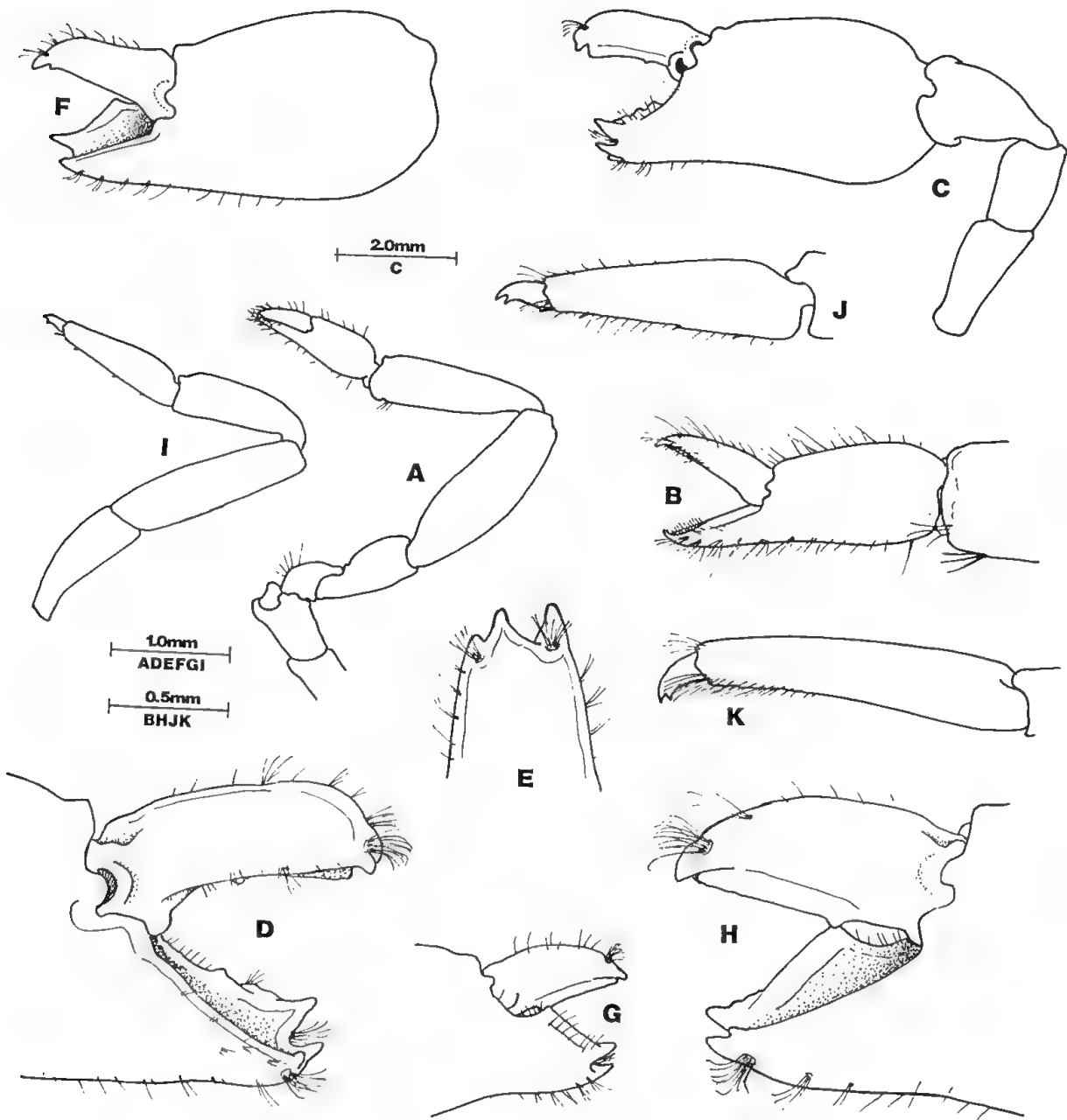


Fig. 3. *Onyccaris anomala* sp. nov., ovigerous female, paratype. A, mandible. B, molar process. C, distal incisor process. D, maxillula. E, palp of maxillula. F, maxilla. G, first maxilliped (flattened). H, second maxilliped. I, third maxilliped.

The maxilla has a stout, centrally swollen palp, with a few preterminal setae on the medial border. The endite is greatly elongated, strongly bowed and oriented at right angles to the plane of the exopod, and narrow, reaching almost to the level of the tip of the palp, with a small notch half way along the medial border, and with a small rounded lobe proximally. The medial border bears a well developed fringe of uniform slender setae, except on the proximal lobe. The scaphognathite is long, about 2.8 times longer than wide, with a well developed narrow posterior lobe and a broad, medially concave anterior lobe.

The first maxilliped has a stout subcylindrical palp with several setae disto-medially. The basal endite is narrow and greatly elongated, reaching almost to the tip of the palp, strongly bowed and oriented at right angles to the exopod. The medial border is entire and provided with a fringe of long slender setae, with shorter setae on the disto-lateral border. The coxal endite is small, rounded and without setae. The exopod is well developed, with a long narrow caridean lobe and a short, slender flagellum. The flagellum bears four long plumose terminal setae and is also provided with short setae along its medial and lateral borders. A large bilobed epipod is present.

The second maxilliped is normal. The distal segment is small, about 2.5 times longer than wide, with several rows of spines along the medial border. The penultimate segment is large, with a well developed disto-medial angle bearing 11-12 long spines. The carpus, merus and ischio-basis present no special features. The exopod has a well developed flagellum, 4-6 long plumose distal setae, with shorter setae along medial and lateral borders. The coxa is not produced medially and a large simple, distally rounded epipod, without a podobranch, is present laterally.

The third maxilliped has the ischio-merus and basis completely fused to form a single segment. This antepenultimate segment is about 3.0 times longer than wide, strongly bowed, tapering distally with a straight lateral border, and a feebly convex medial border. The lateral margin bears numerous short slender setae. The medial margin is sparsely setose, but the ventral medial aspect bears numerous small sub-spherical tubercles throughout its length. The penultimate segment is not attached terminally but arises from a preterminal ventro-medial position. The distal margin of the antepenultimate segment is rounded and bears tubercles similar to those of the medial border. The penultimate segment is robust, moderately compressed, about twice as long as wide and about 0.4 of the length of the antepenultimate segment. The ventral aspect bears small rounded tubercles and numerous groups of slender setae. The terminal segment is about 0.6 of the length of the penultimate and about 2.2 times longer than wide, with numerous groups of setae. The exopod is well developed, broad, exceeding the length of the antepenultimate segment, with long plumose setae distally and short setae along its medial and lateral margins. The coxal segment is broad, strongly compressed and dorsally excavate, but not produced medially and with a low elongated epipod laterally. There is no arthrobranch.

The first pereopods are normal. The chela has a subcylindrical, slightly compressed and distally tapering palm, about 1.8 times longer than deep. The fingers are slender, tapering, about 0.65 of the palm length, with small hooked tips and a sharp cutting edge along the distal halves of the opposing edges only. The palm and fingers bear numerous fine setae. The carpus is about 1.4 of the length of the chela, 3.6 times longer than wide, moderately enlarged distally and with a small group of cleaning setae disto-ventrally. The merus is about 1.15 times the length of the carpus, 3.3 times longer than wide and markedly narrowed proximally. The ischium is a little less than half the length of the basis, 2.2 times longer than wide and 1.5 times the length of the basis. The coxa is without a medial ventral process.

The second pereopods are well developed with large, stout, smooth, and unequal chelae. The palm of the major chela is strongly compressed, about 1.5 times longer than deep, with the ventral border feebly concave. The fingers are robust, equal to about half the palm length. The dactylus is moderately compressed, but thickened ventrally, with a stout cutting edge bearing a small acute tooth at one third of its length. A deep notch separates the distal end of the cutting edge from the slightly swollen anterior end which bears a short, blunt hooked tip. A well marked dactylar fossa is present proximally. The fixed finger is stout and broad, deeply grooved throughout its length to receive the thickened cutting edge of the dactylus. The distal end bears a large hooked tooth on each side of the groove, with a smaller additional tooth medially. The largest tooth is on the lateral edge and a few low irregular teeth are also present on the distal half of this margin. The carpus is about twice as long as wide, a little less than half the palm length, broadly expanded distally and unarmed. The merus and ischium are unarmed. The merus is about 0.4 of the palm length, and 1.4 times longer than wide. The ischium is about 0.5 of the palm length, 1.4 of the merus length and 2.3 times longer than wide. The basis and coxa are stout and present no special features. The chela of the minor second pereopod is about half the length of the first. The palm is strongly compressed, about 1.4 times longer than deep, tapering distally and with a convex or straight ventral border. The dactylus is about 0.6 of the palm length, 2.5 times longer than deep, with a blunt hooked tip and a straight cutting edge bearing a single small tooth at one third of its length, and with a small notch between the distal end of the cutting edge and the tip. The fixed finger is deeply channeled throughout its length to receive the cutting edge of the dactylus. The raised edges of the groove end in large teeth separated by a deep notch. The medial edge is unarmed and feebly concave. The lateral side is elevated to form a large triangular tooth, which opposes the edge of the dactylus with a shearing action. The carpus, merus and ischium are similar to the major pereopod, but smaller.

The ambulatory pereopods are normally developed, and mainly detached. The third (?) has a short, stout biunguiculate dactylus. The unguis is distinct and slightly larger than the accessory spine. The corpus is compressed, about 1.75 times longer than deep, tapering distally and with a series of five accessory setae disto-ventrally. The ventral border bears a series of about 9 small subacute denticles. The propod is about 4.7 times the length of the dactylus, 3.5 times longer than wide, 2.1 times as wide proximally as distally, with a single large spine disto-ventrally and three small spines along the ventral border. The carpus is unarmed, subequal to the length of the propod. The merus is 1.5 times the propod length and 4.0 times longer than wide. The ischium is subequal to the propod length, 3.1 times longer than wide, and distinctly narrowed proximally. Both merus and ischium are unarmed. The fifth pereopod is similar. The dactylus is of similar length, biunguiculate, with ten small denticles ventrally on the carpus. The propod is 1.3 times the length of that of the third pereopod, 4.8 times longer than wide, tapering gradually distally, with numerous setae disto-ventrally but without any spines.

The pleopods are detached. The uropods have a short, stout unarmed protopodite. The exopod is about twice as long as wide, with a strongly convex lateral border, ending in a small blunt tooth, with a slender mobile spine medially. The endopod is subequal to the length of the exopod, which it slightly exceeds, and is about 2.2 times longer than wide.

The ova are numerous and small.

TYPES. The ovigerous female with the bidentate rostrum, P. 24994, is designated as the holotype, the other two females as paratypes. The specimens are deposited in the collections of the Australian Museum.

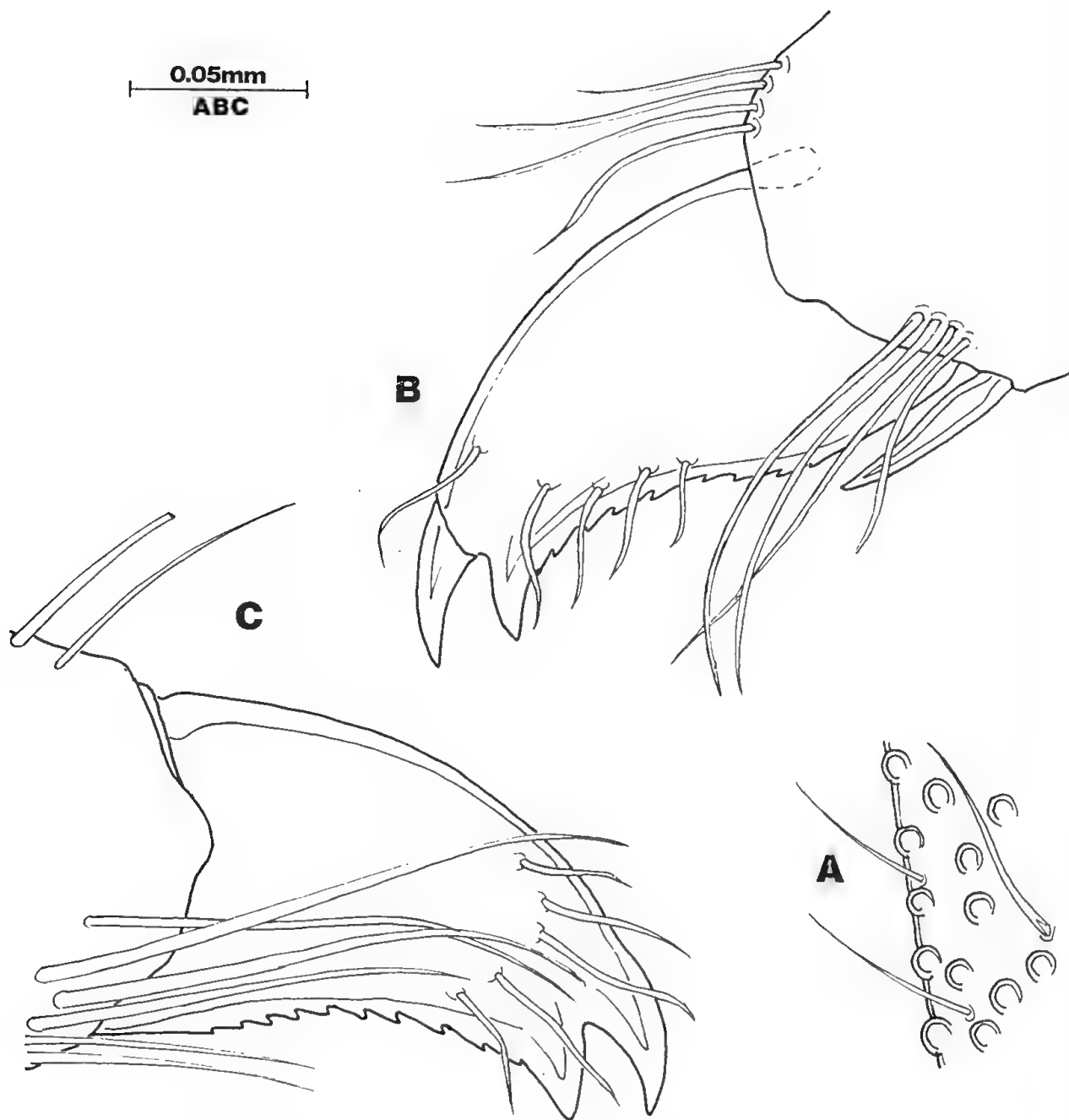


Fig. 4. *Onycocaris anomala* sp. nov., ovigerous female, holotype. A, antepenultimate segment of third maxilliped, ventro-medial margin. B, dactyl of third pereopod. C, dactyl of fifth pereopod.

MEASUREMENTS.

(In mm)	Holotype	Paratype (i)	Paratype (ii)
Post-orbital carapace length	3.8	4.0	3.7
Major chela	—	6.0	—
Minor chela	—	3.3	—
Length of ovum	—	1.0	—

REMARKS. There is no data available on coloration, host or habitat. The label records that the specimens were found amongst dead coral and sponges and it is probable that they were associated with the latter.

Only one pair of second pereopods are preserved from the three specimens. These appear to be a pair and are provisionally attributed to the larger paratype specimen. The ovigerous female paratype specimen has only a single dorsal rostral tooth. From its appearance, it is likely that this rostrum may be slightly abnormal, with less than its full dentition. The rostrum of the second paratype female is largely missing and the dentition unknown, but from the length of the stump, is unlikely to have exceeded two teeth.

The Systematic Position of *Onycocaris anomala* sp. nov.

The three specimens are considered to belong to the genus *Onycocaris* Nobili on account of the morphology of the chelae of the second pereopods. Eleven species have so far been referred to this genus and a key to these has been provided by Bruce (1978). From this key *O. anomala* appears to be most closely related to *O. seychellensis* Bruce, and *O. zanzibarica* Bruce, both species with dorsally dentate rostra. *Onycocaris anomala* may be readily separated from both these species by the form of the chelae of the second pereopods, especially the characteristic dentition of the fingers. In both species the cutting edge of the dactylus is multidentate and neither has a shearing mechanism on the fingers of the minor chela.

DISCUSSION

The true systematic position of *Onycocaris anomala* is obscure, as it presents some marked morphological differences from the other species of the genus, including *O. seychellensis* and *O. zanzibarica*, to which it shows most resemblance. The most note-worthy differences are in the maxilla and first maxilliped, which show a most marked resemblance to those of *Typton dentatus* Fujino and Miyake, 1969. The mouthparts of this species of the genus *Typton* are also markedly different from all other known species of its genus. In view of the very close resemblance of these appendages, *O. anomala* and *T. dentatus* must be considered as very closely related.

In their general morphology, the two species show great similarity, but unfortunately the second pereopods of *T. dentatus*, which would provide most useful additional information on the relationship of the two species to the genera *Onycocaris* and *Typton*, are not known. The two may be readily separated at species level by the following features:

O. anomala sp. nov.

1. Rostrum with 1-2 small dorsal teeth.
2. Proximal segment of antennular peduncle without acute disto-lateral spine.
3. Scaphocerite normal but small, with distinct disto-lateral tooth distinctly exceeding proximal end of carpocerite.
4. Incisor process of mandible distally tridentate, with two long spines.

T. dentatus Fujino & Miyake

- Rostrum with 3 large dorsal teeth.
Acute disto-lateral spine present on proximal segment of antennular peduncle.
Scaphocerite rudimentary, barely reaching proximal end of carpocerite, without disto-lateral tooth.
Incisor process of mandible bidentate, without long spines.

- | | |
|--|---|
| 5. Antepenultimate segment of third maxilliped ventro-medially tuberculate.
6. Third pereopod with disto-ventral and ventral propod spines.
7. Corpus of ambulatory pereopod dactylus with 9-10 denticles ventrally.
8. Telson with small dorsal spines at approximately 0.33 and 0.66 of length. | Antepenultimate segment of third maxilliped non-tuberculate.

Third pereopod with disto-ventral spines only.
Corpus of ambulatory pereopod dactylus with 3-4 denticles.
Telson with minute dorsal spines at approximately 0.5 and 0.75 of length. |
|--|---|

T. dentatus was referred to the genus *Typton* by Fujino and Miyake on account of the marked reduction of the scaphocerite, despite the fact that the rostrum was strongly dentate, whereas it is simple in all other species. Holthuis's (1951) definition of the genus was amended by them to include this form. The marked differences in the mouthparts from other *Typton* species was not discussed.

O. anomala is provisionally referred to the genus *Onycocaris*, despite the marked differences in mouthparts, on account of the chelae of the second pereopods, which are high and compressed (Holthuis 1952, 1956), with a deeply bifid tip to the fixed finger, much as is found in several species of *Onycocaris*. The minor chela, however, shows a large triangular tooth on the outer aspect of the fixed finger, with a shearing dactylus, features not found in other species of *Onycocaris* but reported in some species of *Typton*, i.e. *T. bawii*, of which only the minor chela is known (Bruce, 1972).

The marked differences in the maxillae and first maxillipeds of the two species *O. anomala* and *T. dentatus* from the other species of their genera imply that a distinct difference in their feeding strategy has been evolved. The dense extensive fringes of uniform setae suggest a filtering or sweeping function for these appendages. The relatively strongly setose exopods of the maxillipeds in *O. anomala* may indicate the possibility of a feeding current being created, but these are not indicated in Fujino and Miyake's description of *T. dentatus*. If further specimens of *T. dentatus* are obtained with second pereopods similar to those of *O. anomala*, and not typical of *Typton* spp., it would suggest that the two species should be removed from their present genera and placed in a genus of their own.

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AN ANNOTATED CHECK-LIST OF AUSTRALIAN AND NEW ZEALAND POLYCHAETA, ARCHIANNELIDA AND MYZOSTOMIDA

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ABSTRACT

All the published records of Polychaeta, Archiannelia and Myzostomida from the seas around Australia and New Zealand have been extracted from over 200 publications. The currently accepted specific names are listed alphabetically family by family and each is followed by the synonyms that have been used in the publications dealing with the region. All locality records are given as degrees of latitude and longitude with a symbol to indicate the depth range. A map marked with two degree latitude/longitude squares is given for ease of reference. The repositories of the collections and of the types of species first described from Australia and New Zealand are shown.

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INTRODUCTION

The records of Australian and New Zealand Polychaeta are spread through 184 publications many of which are in old or obscure journals. Moreover more than half the specific names are obsolete, others are misidentifications and some of the "new" species should obviously be sunk in the synonymy. Further the locality records are so numerous and scattered that it takes days to determine the geographic distribution of any species. For all these reasons it is hoped that this check list which includes all the published records of the Archiannelida, Myzostomida and Polychaeta will be useful to later workers.

The list has several limitations. While it includes records from the Australian-New Zealand region from the Torres Straits in 10° south to Campbell Island in 52° south and outlying islands such as Lord Howe, Kermadec, Chatham, Snares and Auckland, it excludes records from Cocos and the Indonesia-New Guinea area in the north, the South Pacific islands to the east and many subantarctic islands south of New Zealand. We have also excluded our own unpublished records and those of common species in ecological papers which merely confirm the known geographic range. Similarly we have excluded repetitions of earlier records such as those given by Baird (1865), Quatrefages (1865), Hutton (1879), Haswell (1883), Whitelegge (1889) and Fyfe (1952) unless they show changes in nomenclature or include useful notes.

THE FORMAT OF THE CHECK-LIST

Within each family what we regard as the valid specific names are listed in alphabetical order with the synonyms inset below each. Each specific name is followed by the author's name and date and then the locality records. In order to distinguish the type locality from others this is shown separately and later records are shown below. No locality record is given for types first described from any area outside the Australian-New Zealand region so that it is possible to distinguish these "foreign" species.

Since many of the place names that have been used in the references are difficult to locate even with a good gazetteer, all locality records are given in degrees of latitude and longitude. With the exception of Kermadec Island and some islands of the Chatham group which are in west longitude, the whole Australian-New Zealand region is in south latitude and east longitude. It is thus possible to save space by omitting the letters S (south) and E (east) after the degrees of latitude and longitude except for Kermadec and some of the Chatham Island records which are marked W (west). For the sake of brevity only degrees are given and minutes of latitude and longitude are omitted. Thus Port Jackson (Sydney Harbour) in 33°58'S, 151°00'E is reduced to 33/151. The numerous records from in and around Port Jackson including those from the famous collecting site at Long Reef, Collaroy all fall within this latitude/longitude square of 60 x 60 nautical miles and all are shown by the one record. It is appreciated that this method of presentation does not

define the exact collecting site but it is sufficient for taxonomic and zoogeographic purposes and saves a great deal of space. If more exact records are required for ecological studies, the list of references given for that species may be consulted. Depth records are also summarised and represented by the following symbols: "i" indicates intertidal records; "e" = estuarine; "p" = planktonic; "t" = turbulent zone (0-30 m); "o" = outer shelf (31-100 m); "d" = deep (101-500 m); "vd" = very deep (501-1000 m); "a" = archibenthal or abyssal (over 1000 m), "fw" = freshwater. For example a record from Perth on the Swan River estuary is shown as 32/115/e; one from Rottnest Island in 10 m is shown as 32/115/t and one from the shore of Cockburn Sound is shown as 32/115/i. All three records are summarised as 32/115/e, i, t. It should be noted that many of the original records do not give the depth and these are shown by "?"; probably most of these were intertidal or shallow-water records. A map marked with two degree latitude/longitude squares is provided for ease of reference (Fig. 1), and the records are grouped for each state or country which is indicated by the letters NT for Northern Territories, WA for Western Australia, QLD for Queensland, NSW for New South Wales, SA for South Australia, TAS for Tasmania, and NZ for New Zealand. Records for Kermadec Is., Chatham Is., Auckland Is. and Campbell Is. are written out in full.

SYNONYMY

The synonyms are listed in date order below each valid specific name with the relevant references and records. It has been necessary to use discretion in listing synonymy for even well-known workers do not always agree. The widely accepted synonyms are listed by Hartman (1959, 1965) and many others have been extracted from recent reviews of genera by workers such as Pettibone on certain Polynoidae and Sigalionidae, Imajima on the Syllidae, Banse on the Fabriciinae, ten Hove and Zibrowius on the Serpulinae and Knight-Jones on the Spirorbinae. In controversial cases we have quoted the conflicting views of the main authorities. In spite of this it is obvious that much remains to be done before all the invalid records are eliminated. In many cases it will demand a re-examination of older collections and the types of Australian and New Zealand species. To facilitate such work the repositories of species described from the area are listed below as far as they could be ascertained.

REPOSITORIES OF COLLECTIONS AND TYPE MATERIAL

Unfortunately very few early workers state where their collections are deposited, and the list below is based partly on the title of the paper or the journal in which it was published supplemented by inquiries at different museums. It should be noted that some specimens in German museums were destroyed during the war.

Ashworth's collections of Arenicolidae are in the British Museum of Natural History. Augener's material is in many different museums; the specimens he described in 1913, 1914, and 1922A are in the Zoologisches Institut und Zoologisches Museum der Universität Hamburg; those described in 1922B and 1922C are in the Naturhistoriska Rijsmuseet Stockholm; those in 1924A, 1924B, 1926 and 1927A are either in the Zoological Museum of Copenhagen or the Zoologisches Institut und Zoologisches Museum der Universität Hamburg while those in his 1927B paper are in the Berlin Naturhistorisches Museum.

Baird's collections are in the British Museum of Natural History.

Benham's New Zealand collections are mostly in the Otago Museum, Dunedin. Some specimens collected by the 'Endeavour' (Benham 1915A, 1916B) are in the Australian Museum and some of the specimens collected by the 'Terra Nova' expedition

(Benham 1927, 1929) are in the British Museum of Natural History. Benham did not designate types.

Day's (1975) specimens are in the Western Australian Museum in Perth while the review of Orbiniidae (Day, 1977) is based on material in the Australian Museum unless otherwise stated.

Ehlers' collections were removed from the Zoologisches Institut der Universität Göttingen, some are now in the Zoologisches Museum der Universität Hamburg and others may be in the Berlin Naturhistorisches Museum. Ehlers did not designate types.

Fauvel's material reported in 1917 and 1922 is in the Museum National d'Histoire Naturelle in Paris.

Grube's material is mainly deposited in the Berlin Naturhistorisches Museum.

Hartman's specimens of Nereidae described in 1954 are in the Allan Hancock Museum, Los Angeles while the other polychaetes she described in 1963 and 1966 are in the Australian Museum.

Haswell's collections were in the Macleay Museum of the University of Sydney but unfortunately many specimens were lost before they were transferred to the Australian Museum. Haswell did not designate types.

Hutchings' collections are mainly in the Australian Museum.

Kingberg's collections were all in the Naturhistoriska Rijsmuseum in Stockholm but some specimens have been lost.

Knight-Jones' types of Spirorbinae are in the British Museum of Natural History.

Knox's New Zealand types are in the Canterbury Museum in Christchurch but the collection from Port Phillip Bay described by Knox and Cameron (1971) is in the National Museum of Victoria in Melbourne.

Lamarck's collections are in the Museum National d'Histoire Naturelle in Paris.

McIntosh (1885) — The 'Challenger' collection was in the Gatty Laboratory, St. Andrews but was later moved to the British Museum of Natural History and some specimens were lost.

Monro's material is all in the British Museum of Natural History.

Mörch's collection of Serpulidae is mostly in the Zoological Museum of Copenhagen but some specimens have found their way to the British Museum of Natural History and elsewhere.

Pope's (1943) collection identified by Monro is in the Australian Museum.

Quatrefages' collection is in the Museum National d'Histoire Naturelle in Paris.

Rullier's (1965) material is in the Queensland Museum in Brisbane but some types are in the Australian Museum.

Schmarda's collection was in the Zoologisches Institut der Universität Wien but many specimens have been destroyed.

Straughan's collection of Serpulidae is mainly in the Australian Museum.

Wells' collection of Arenicolidae is in the British Museum of Natural History.

The repository of types which were first described from Australian or New Zealand waters, if known is indicated in the margin of the check-list by the symbols given below. The location of the types of "foreign" species is left blank.

AHM	— Allan Hancock Museum, Los Angeles.
AM	— Australian Museum, Sydney.
BM	— British Museum of Natural History, London.
BNM	— Berlin Naturhistorisches Museum.
CM	— Canterbury Museum, Christchurch.
GZM	— Zoologisches Institut der Universität Göttingen.
HZM	— Zoologisches Institut und Zoologisches Museum der Universität Hamburg.
KM	— Zoological Museum of Copenhagen.
NZOI	— New Zealand Oceanographic Institute, Wellington.
OM	— Otago Museum, Dunedin.
MNHN	— Museum National d'Histoire Naturelle, Paris.
NMW	— National Museum, Wellington.
QM	— Queensland Museum, Brisbane.
SAM	— South Australian Museum, Adelaide.
SSM	— Naturhistoriska Rijsmuseum, Stockholm.
USNM	— National Museum of Natural History; Smithsonian Institution, Washington, D.C.
NMV	— National Museum of Victoria, Melbourne.
WAM	— Western Australian Museum, Perth.
ZMA	— Zoologisch Museum, Universiteit Van Amsterdam.
ZUW	— Zoologisches Institut der Universität Wien.

Symbols preceded by ? (e.g. ?BM) indicate that the type should be in this museum but may be lost; if the type has definitely been checked as missing it is marked "lost".

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MYZOSTOMIDA

MYZOSTOMIDAE

Myzostomum atrum Atkins 1927 — QLD 10/142/t

Myzostomum coriaceum von Graff 1884 — QLD 19/148/?

Myzostomum dentatum von Graff 1884 — QLD 10/142/?

- Myzostomum horologium* von Graff 1884 — QLD 10/142/?
Myzostomum insigne Atkins 1927 — QLD 10/142/t
Myzostomum intermedium von Graff 1884 — QLD 10/142/?
Myzostomum plicatum von Graff 1884 — QLD 10/142/?
Myzostomum polycyclus Atkins 1927 — QLD 10/142/t
Myzostomum pottsi Atkins 1927 — QLD 10/142/t
Myzostomum quadrifilum von Graff 1884 — QLD 10/142/?
Myzostomum stochoeides Atkins 1927 — QLD 10/142/t
Myzostomum tenuispinum von Graff 1884 — Kermadec Is. 28/177W/a
Myzostomum viride Atkins 1927 — QLD 10/142/t
Myzostomum willemoesi von Graff 1884 — Kermadec Is. 28/177W/a

ARCHIANNELIDA

NERILLIDAE

- Nerilla australis* Willis 1951 — VIC 38/145/e

POLYCHAETA : ERRANTIA

APHRODITIDAE

- Aphrodita armifera* Moore 1910 (fide Fauvel 1925)
 as *Aphrodite talpa* (non Quatrefages) Fauvel 1917 — SA 34/138/?
 BM *Aphrodita australis* Baird 1865c — NZ 43/172/?
 Haswell 1883A, McIntosh 1885, Fauvel 1917, Augener 1922A, 1924B,
 Knox 1960A — SA 34/137/?; 34/138/?; 35/137/?; NSW 32/152/?;
 33/151/o; NZ 26/137/o; Chatham Is. 43/177W/d
 as *Aphrodite talpa* (non Quatrefages) Ehlers 1907, Benham 1909, Augener
 1922A — NZ 45/177/o; 46/169/o
 as *Aphrodite terraereginae* (non Haswell) Ehlers 1907, Benham 1909 — NZ
 40/172/t; 45/170/o
 as *Aphrodita haswelli* Johnston 1909 — NZ 41/173/i; 45/170/?
 ?OM *Aphrodita maorica* Benham 1900 — NZ 40/172/t; 40/173/t
 ?BNM *Aphrodita paleacea* Peters 1864 — SA 35/138/?
 ?MNHN *Aphrodita talpa* Quatrefages 1865 — New Zealand
 Benham 1900, Fauvel 1925, Monro 1936, Knox 1960A, 1965 — NZ
 35/172/o; 35/173/o; 44/167/d; Chatham Is. 143/177W/o,d; 44/176W/vd
 lost *Aphrodita terraereginae* Haswell 1883A — QLD 14/144/?
Aphrogenia alba Kinberg 1856 ? locality; (type locality West Indies — fide
 Hartman 1959)
Aphrogenia dolichoceras Haswell 1883A — fide Kudenov — pers. comm.

- AM as *Hermione (Aphrogenia) dolichoceras* Haswell 1883A — QLD 20/148/t
- HZM *Aphrogenia margaritacea* Augener 1913 — WA 26/113/t; 33/115/t
Aphrogenia nigropunctata Horst 1917
 Monro 1924B — QLD 10/143/?
- AM *Hermonia brachyceras* (Haswell 1883A) fide Hartman 1959
 as *Hermione brachyeras* Haswell 1883A — QLD 20/148/t
Hermonia macleari (Haswell 1883A) fide Hartman 1959
- lost as *Hermione macleari* Haswell 1883A — QLD 20/148/t
- BM *Laetmonice producta* var. *benthaliana* McIntosh 1885
 Benham 1921 — NZ 42/148/a
- BM *Laetmonice producta* var. *willemoesi* McIntosh 1885 — NZ 37/179/a
Pontogenia araeoceras (Haswell 1883) — fide Kudenov — pers. comm.
- AM as *Triceratia araeoceras* Haswell 1883A — QLD 20/148/t
Pontogenia villosa Horst 1917
 Monro 1931 — QLD 16/145/i
- POLYNOIDAE
- Antinoe antarctica* (Bergström 1916)
 Knox 1960A — Chatham Is. 43/177/vd
- Antinoe epitoca* Monro 1930
 Knox 1960A — Chatham Is. 43/179/vd
- Antinoe kermadecensis* (McIntosh 1885)
 Knox 1960A — Chatham Is. 43/178/vd
- BM as *Lagisca kermadecensis* McIntosh 1885 — Kermadec Is. 29/178/vd
- lost *Antinoe pachylepis* Haswell 1883A — NSW 33/151/i
- CM *Antinoe purpureus* Knox 1960A — Chatham Is. 43/179/vd
Australaugeneria rutilans (Grube 1878) — fide Pettibone 1969
- HZM as *Scalisetosus hartmeyeri* Augener 1913 (partim) — WA 25/113/t
- USNM *Australaugeneria michaelsoni* Pettibone 1969
 as *Scalisetosus hartmeyeri* Augener 1913 (partim) — WA 25/113/t
- BM *Eunoe abyssorum* McIntosh 1885 — SA 42/134/a
- OM *Eunoe etheridgei* Benham 1915
 as *Harmothoe (Eunoe) etheridgei* Benham 1915A — VIC 37/150/d
- BM *Eunoe iphionoides* McIntosh 1885 — NZ 38/169/d
 Knox 1960A — Chatham Is. 43/179/d; 43/177W/d
- CM *Euphione ornata* Knox 1960A — Chatham Is. 44/175W/d
Euphione squamosa (Quatrefages 1865)
 Augener 1924B, Monro 1939, Knox 1951B, 1960A — TAS 42/148/d; NZ
 40/173/d; Chatham Is. 43/176W/o

- ?MNHN as *Aphrodite squamosa* Quatrefages 1865 — NZ 45/171/?
 as *Lepidonotus giganteus* Kirk 1879 — NZ (record repeated) Benham 1900 — NZ "east coast of south island"
 as *Physalidonotus squamosus* Ehlers 1904, 1907, Benham 1909 — NZ 43/172/o; 45/171/i,o
- OM as *Physalidonotus laevis* Benham 1915A — VIC 37/149/d; 37/150/d
- OM as *Physalidonotus paucibranchus* Benham 1915A — VIC 37/150/d
- OM as *Physalidonotus rugosus* Benham 1915A — VIC 37/149/d; 39/148/d; 40/147/d; TAS 42/148/d
- ?OM as *Physalidonotus thomsoni* Benham 1916A — NZ 45/170/?
- OM as *Physalidonotus turritus* Benham 1915A — VIC 39/148/d
- Evarnella impar* (Johnston 1839)
 as *Harmothoe impar* Monro 1939 — TAS 43/147/i
- Gastrolepidia clavigera* Schmarda 1861
 Monro 1931 — QLD 16/145/i, t
- Harmothoe crosetensis* (McIntosh 1885)
 Knox 1960A — Chatham Is. 43/179/d
- Harmothoe dictyophora* (Grube 1878A)
 Augener 1913, 1922B — WA 19/120/t; 25/113/t
- Harmothoe minuta oculata* Potts 1915 — QLD 10/142/i
- Harmothoe praeclara* (Haswell 1883A)
 Augener 1924B, 1927A, 1932, Knox 1965, Day 1975 — WA 32/115/t; NSW 33/151/i; 37/150/o; NZ 44/167/d; 45/170/t
- AM as *Antinoe praeclara* Haswell 1883A — NSW 33/151/i
- AM ?as *Antinoe ascidiicola* Haswell 1883A — NSW 33/151/i, t
 as *Harmothoe spinosa* (non Kinberg) Ehlers 1907 — NZ 45/170/t, o
- BM as *Harmothoe terminoculata* Monro 1924A — fide Day 1975
 Monro 1924A — NSW 33/151/i
- as *Harmothoe waahli* (non Kinberg) Augener 1913 — WA 25/113/t; 32/115/i, t; 33/115/t
- Harmothoe spinosa* Kinberg 1857
 Fauvel 1917, Augener 1924B, Knox and Cameron 1971, Poore et al., 1975 — SA 34/137/?; 34/138/?; VIC 38/144/i, t; 38/145/i, t; NZ 41/174/t
- Harmothoe waahli* (Kinberg 1856)
 Monro 1938 — WA 32/115/e
- SSM as *Antinoe waahli* Kinberg 1856 — NSW 33/151/i
Herdmanella ascidioides (McIntosh 1885) — fide Hartman 1959
- BM as *Polynoe? ascidioides* McIntosh 1885 — SA 42/134/a
Hermenia acantholepis (Grube 1878)

- as *Lepidonotus acantholepis* Fauvel 1922 — WA 29/113/?i
Hololepidella commensalis Willey 1905
 Augener 1922B — WA 19/120/t (doubtful)
- Hyperhalosydna striata* (Kinberg 1856) — fide Augener 1922c
 Augener 1922C, 1927A, Monro 1939, Knox 1960A, Rullier 1965 — TAS
 42/148/d; VIC 38/149/d; NSW 37/150/o; QLD 27/153/t; Chatham Is.
 44/175W/d
- SSM as *Lepidonotus striatus* Kinberg 1856 — NSW 33/151/i
 as *Polynoe striata* — Quatrefages 1865, Haswell 1883A — record repeated
 as *Polynoe (Lepidonotus) striata* — Grube 1878A — WA 17/119/?
- lost as *Polynoe ochthoebolepis* Haswell 1883A — QLD 19/148/t; 20/148/t
- BM as *Polynoe platycirrus* McIntosh 1885 — VIC 39/146/o
 Benham 1915A, Knox 1951B — VIC 37/150/d; 39/148/d; NZ 40/173/d
 as *Halosydna striata* Monro 1924A — QLD 10/142/t; 20/149/i
- Iphione muricata* (Savigny 1818)
 Augener 1913, 1922A, 1922B, Monro 1924A, 1931 — WA 19/118/i;
 19/120/t; QLD 10/142/t; 14/145/t; 16/145/i; 20/148/i
- ?MNHN as *Iphione fimbriata* Quatrefages 1865 — QLD 10/142/?
- ?SSM as *Iphione ovata* Kinberg 1856
 Haswell 1883A — QLD 10/142/i; 20/148/i
Iphione hystrix Collin 1902 — QLD 10/142/? (indeterminate)
- Kermadecella magnipalpa* (McIntosh 1885) — fide Hartman 1959
- BM as *Polynoe magnipalpa* McIntosh 1885 — Kermadec 28/177W/a
- CM *Lepidametria brunnea* Knox 1960A — Chatham Is. 43/177W/o
- NZOI *Lepidasthenia accolus* Estcourt 1967 — NZ 43/172/e
- BM *Lepidasthenia antipathicola* Benham 1927 — NZ 34/173/d
Lepidasthenia interrupta (Marenzeller 1902)
 Monro 1939 — WA 35/118/o
- HZM *Lepidasthenia michaelsoni* Augener 1913 — WA 32/115/t
 Day 1975 — WA 32/115/t
- BM, AM as *Lepidasthenia terraereginae* Monro 1931 — fide Day 1975 — QLD
 16/145/i
- CM, NMW *Lepidasthenia platylepsis* Knox 1960A — Chatham Is. 44/175W/d
- Lepidastheniella comma* (Thomson 1901)
 Benham 1950, Wood 1968 — NZ 36/174/i; 43/169/?
 as *Polynoe comma* Thomson 1901 — NZ 43/169/?
 as *Lepidametria comma* Augener 1924A, 1924B — NZ 36/174/i; 43/172/t;
 Auckland Is. 50/166/i

- as *Lepidasthenia comma* Ehlers 1907, Fyfe 1952 — NZ 36/174/?; 45/170/i
- ZUW ?as *Polynoe aucklandica* Schmarda 1861 — NZ 36/174/i
- BM *Lepidastheniella monroi* Benham 1950 — Auckland Is. 50/166/?
as *Lepidastheniella comma* (non Thomson) — fide Benham
Monro 1924A — NZ 45/170/i
- BM *Lepidastheniella phillipensis* Monro 1924A — VIC 38/144/?
as *Lepidasthenia comma* (non Thomson) — fide Monro 1924A
Fauvel 1917 — SA 34/138/?
- Lepidonotus adpersus* Grube 1878A
Augener 1922C — QLD 10/142/?
- lost *Lepidonotus aeololepis* Haswell 1883A — QLD 10/142/i
- CM *Lepidonotus ambigua* Knox 1960A — Chatham Is. 43/178/vd
Lepidonotus argus (Quatrefages 1865)
Fauvel 1917 — SA 34/137/?
- ?MNHN as *Polynoe argus* Quatrefages 1865 — VIC 38/145/?i
as *Thormora argus* Haswell 1883A, Pope 1943 — VIC 38/145/t; NSW
33/151/i
= *Lepidonotus (Thormora) jukesii* — fide Augener 1927A
- CM *Lepidonotus banksi* Knox 1951B, 1956 — NZ 40/173/d
- BM *Lepidonotus bowerbankii* Baird 1865C — Australia
Haswell 1883A, Fauvel 1917, Pope 1943, Day 1975 — WA 32/115/t; SA
34/138/?; NSW 33/151/i
- WAM *Lepidonotus brunneus* Day 1975 — WA 32/115/t
Lepidonotus carinulatus Grube 1870
Fauvel 1922, Rullier 1965, Day 1975 — WA 29/113/i; 32/115/t; QLD
27/153/i, t
Lepidonotus contaminatus (Grube 1876)
as *Polynoe contaminata* Grube 1876 — QLD 10/142/i
Lepidonotus cristatus (Grube 1875)
McIntosh 1885, Fauvel 1922, Monro 1928, Day 1975 — WA 29/113/?;
35/117/?; QLD 10/142/t
- lost *Lepidonotus dictyolepis* Haswell 1883A — NSW 33/151/t
Augener 1927A, Day 1975 — WA 32/115/t; NSW 33/151/t
- CM *Lepidonotus fiordlandica* Knox 1956 — NZ 45/166/?
Lepidonotus furcillatus Ehlers 1901
Augener 1913 — WA 25/113/t; 32/115/t
Lepidonotus glaucus (Peters 1854)
- ?ZUW as *Polynoe australis* Schmarda 1861 (Homonym) — NSW 33/151/i

- as *Antinoe? australis* Haswell 1883A — record repeated
- ?MNHN as *Polynoe grisea* Quatrefages 1865 — NSW 33/151/i
as *Antinoe? grisea* Haswell 1883A — record repeated
- BM as *Lepidonotus stellatus* Baird 1865C — Australia (fide Day)
Haswell 1883A, Augener 1913, 1922B, Fauvel 1917 — WA 19/120/t;
25/113/t; 35/117/t; SA 34/138/?
- HZM *Lepidonotus impatiens* var. *meridionalis* Augener 1913 — WA 33/115/t
- SSM *Lepidonotus jacksoni* Kinberg 1856 — NSW 33/151/t
Augener 1922B, 1922C, 1927A, 1927B, Benham 1927, Knox 1951B,
1956, 1960A, Day 1975 — VIC 38/149/d; NSW 33/151/i; 37/150/o; NZ
34/172/o, d; 34/173/t, d; 35/174/i; 37/176/t; 39/173/t; 40/173/d; 41/173/t;
42/173/?; 43/172/i; 43/173/o; 45/170/i, t; 46/168/t; 47/169/i; Chatham Is.
43/176W/i, t, o
- OM as *Lepidonotus willeyi* Benham 1915A — TAS 42/148/d
- WAM *Lepidonotus (Thormora) jolli* Day 1975 — WA 32/115/i, t
Lepidonotus (Thormora) jukesii Baird 1865C
Augener 1927A, Day 1975 — WA 32/115/t; NSW 33/151/i
- BM as *Thormora jukesii* Baird 1865C — “Australia or New Zealand”
Monro 1924A — QLD 20/149/i
- HZM as *Lepidonotus (Thormora) jukesii* var. *rubra* Augener 1913, 1922B — WA
19/120/t; 25/113/t
as *Thormora johnstoni* (non Kinberg) Monro 1931 — QLD 16/145/i
as *Lepidonotus (Thormora) versicolor* (non Ehlers)
Augener 1913 — WA 32/115/i
- lost *Lepidonotus lissolepis* Haswell 1883A — NSW 33/151/i
Lepidonotus macrolepidotus Schmarda 1861
- ZUW as *Polynoe (Lepidonotus) macrolepidota* Schmarda 1861 — NZ 36/174/i
Ehlers 1904, 1907 — report on type
as ? *Antinoe macrolepidota* Baird 1865C — record repeated
as *Polynoe macrolepidota* Quatrefages 1865 — record repeated
- AM *Lepidonotus melanogrammus* Haswell 1883A — NSW 32/152/t
Fauvel 1917, Augener 1927, Pope 1943, Day 1975 — WA 33/151/i; SA
32/133/i; NSW 33/151/i
- BM *Lepidonotus oculatus* Baird 1865C — VIC 38/145/i
Haswell 1883A, Fauvel 1917, 1922, Augener 1922B, Monro 1928 — WA
19/120/t; 29/113/?; SA 34/138/?; 38/144/?
as *Thormora argus* var. (non Quatrefages) Haswell 1883A
— fide Fauvel 1917, 1922
- ZUW *Lepidonotus polychromus* Schmarda 1861 — NZ (east coast)
Baird 1865C, Ehlers 1904, 1905, 1907, Benham 1909, Augener 1913,
1927B, Monro 1939, Knox 1960A — WA 32/115/i, t; 33/115/t; TAS

- 43/147/i; NZ 34/173/i; 36/174/i, t; 37/176/t; 39/176/t; 39/177/i; 40/173/i;
43/172/t; 45/170/i; 46/168/i; 47/168/i; 47/169/?; Chatham Is. 43/176W/i;
Campbell Is. 52/169/?
- as *Polynoe polychroma* Quatrefages 1865 and Hutton 1879 — "New Zealand"
- Lepidonotus purpureus* Potts 1910 — fide Day 1975
Knox 1960A — Chatham Is. 44/175W/d
- OM as *Lepidonotus hedleyi* Benham 1915A — SA 37/137/o
- lost *Lepidonotus simplicipes* Haswell 1883A — NSW 33/151/t; VIC 38/145/?
= *Lepidonotus melanogrammus* — fide Hartman 1959
- BM *Lepidonotus sinclairi* Baird 1865C — New Zealand
as *Polynoe sinclairi* Hutton 1879 — record repeated
? = *Lepidonotus polychromus* Schmarda — fide Ehlers 1907
- BM *Lepidonotus stephensoni* Monroe 1931 — QLD 16/145/?i
- lost *Lepidonotus torresiensis* Haswell 1883A — QLD 10/142/?
- HZM *Lepidonotus yorkianus* Augener 1922A — QLD 10/142/?
? = *Lepidonotus contaminatus* Grube — fide Augener 1922A
- Macellicephala mirabilis* McIntosh 1885
- BM as *Polynoe (Macellicephala) mirabilis* McIntosh 1885 — NZ 37/179/a
- AM *Malmgrenia monoechinata* Rullier 1965 — QLD 27/153/i
- NMV *Malmgrenia phillipensis* Knox and Cameron 1971 — VIC 38/144/t; 38/145/t
Poore et al., 1975 — VIC 38/144/t
- KM *Nectochaeta australiensis* Augener 1927A — VIC 38/149/p
- BNM *Paralepidonotus ampulliferus* (Grube 1878)
Knox and Cameron 1971, Hutchings and Recher 1974, Poore et al.,
1975 — VIC 38/144/i, t; NSW 33/151/i
as *Harmothoe ampullifera* Augener 1927A — TAS (North West)
- Paralepidonotus boholensis* (Grube 1878)
as *Malmgrenia boholensis* Monroe 1928 — WA 35/117/?
- Paralepidonotus* sp. (fide Hutchings, pers. comm.)
as *Eunoe etheridgei* (non Benham) Hutchings 1974 — NSW 32/152/e
- OM *Polyeunoe flynnii* (Benham 1921) — fide Pettibone 1969
as *Hololepidella flynnii* Benham 1921 — TAS 42/148/a
- Polyeunoe laevis* McIntosh 1885
Knox 1960A — Chatham Is. 44/176W/vd
- Polyeunoe* sp. Knox and Cameron 1971 — VIC 38/144/t
- AM *Polynoe asterolepis* Haswell 1883A — QLD 10/142/i
- ?ZUW *Polynoe aucklandica* Schmarda 1861 — NZ 36/174/i
? = *Lepidastheniella comma* fide Hartman 1959

Polynoe moretonensis (Augener 1922)

HZM as *Hemilepidia moretonensis* Augener 1922A — QLD 27/153/?

Polynoe regalis (Benham 1927)

BM, USNM as *Nemidia regalis* Benham 1927 — NZ 34/172/d

Scalisetosus australiensis Benham 1915A — South Australia
Augener 1924B, 1927A — NSW 37/150/d; NZ 34/172/o

Subadyte mjobergi (Augener 1922) — fide Pettibone 1969

SSM as *Scalisetosus mjobergi* Augener 1922B — WA 19/120/t

Subadyte pellucida (Ehlers 1864) — fide Pettibone 1969
as *Scalisetosus pellucidus* Augener 1913 — WA 25/113/t

POLYDONTIDAE

?BM *Eupanthalis kinbergi* McIntosh 1876
Rullier 1965 — QLD 27/153/t

CM *Eupanthalis* n.sp. Knox 1965 — NZ 44/167/d

CM, NMW *Panthalis novaezealandiae* Knox 1960A — Chatham Is. 43/178/vd; 44/177W/d
Polydontes australiensis (McIntosh 1885) — QLD 10/142/?
Hartman 1966 — NSW 33/151/t

BM as *Eupompe australiensis* McIntosh 1885 — QLD 10/142/t
Benham 1915A — VIC 39/148/d

Polydontes melanonotus (Grube 1878)
Monro 1931 — QLD 16/145/t

SIGALIONIDAE

?*Euleanira* sp. Stephenson et al., 1974 — QLD 27/153/t

Euthalenessa festiva (Grube 1875) — fide Pettibone 1970
as *Thalenessa microceras* (non Baird) Haswell 1883A — QLD 20/148/t

BM as *Thalenessa oculata* McIntosh 1885 — VIC 39/146/o
Benham 1915A — SA 32/133/o

as *Euthalenessa oculata* Monro 1924A — QLD 10/143/t

BM *Euthalenessa fimbriata* (McIntosh 1885) — fide Pettibone 1970
as *Thalenessa fimbriata* McIntosh 1885 — NSW 35/151/o

as *Euthalenessa digitata* (McIntosh) Knox 1960A — Chatham Is. 42/175/d;
44/176W/d

Fimbriosthenelais longipinnis (Grube 1870) — fide Pettibone 1970
as *Sthenelais variabilis* var. *glabra* Potts 1910
Monro 1931 — QLD 20/148/o

Psammolyce antipoda (Schmarda 1861)
Ehlers 1904, 1905, Augener 1913, 1927B, Monro 1924A, Pope 1943,

Fyfe 1952 — WA 29/113/t; SA ?locality; NSW 33/151/i; QLD 9/143/o; NZ 37/176/t; Chatham Is. (i)

- ?ZUW as *Pelogenia antipoda* Schmarda 1861 — New Zealand
- BM *Psammolyce semiglabra* Monro 1936 — NZ 35/172/o
Knox 1960A — Chatham Is. 44/175W/o
- Sigalion amboinensis* Grube 1877
Augener 1927A — NSW 37/149/t
- Sigalion bandaensis* Horst 1917
Rullier 1965 — QLD 27/153/i
- BM *Sigalion ovigerum* Monro 1924A — NSW 33/151/i
Monro 1936, Knox 1960A, Knox and Cameron 1971 — VIC 38/144/t;
NZ 35/173/o; Chatham Is. 43/176W/o; 43/177W/o; 45/175W/d
- Sigalion* sp. Wood 1968 — NZ 36/174/i
- Sthenelais boa* (Johnston 1839)
Rullier 1965, Hutchings 1974 — NSW 32/152/t; QLD 27/153/t
- CM *Sthenelais chathamensis* Knox 1960A — Chatham Is. 43/176W/o
- BM *Sthenelais limicola* var. *novaezealandiae* Monro 1936 — NZ 35/172/o
Sthenelais malayana Horst 1917
Monro 1931 — QLD 16/145/t
- BNM *Sthenelais taurangaensis* Augener 1927B — NZ 37/176/t
- Sthenelais* sp. Augener 1927A — NSW 37/149/o
- Sthenolepis laevis* (McIntosh 1885) — fide Augener 1924B
Augener 1924B, Fyfe 1952, Knox 1965 — NZ 36/174/o; 37/177/o;
44/167/d
- BM as *Leanira laevis* McIntosh 1885 (Homonym) — NZ 41/174/o
Knox 1960A — Chatham Is. 42/175/d; 43/178/vd, 42/176W/t;
43/176W/d; 44/175W/d; 44/176W/vd
- as *Sthenelais semitecta* Ehlers 1864
Benham 1909 — NZ 39/177/o; 43/172/t
- Sthenolepis yhleni* (Malmgren 1867) — fide Hartman 1965
as *Leanira yhleni* Rullier 1965 — QLD 27/153/t
- Sthenolepis* sp. — fide Pettibone 1970
as *Leanira alba* (non Moore) Rullier 1965 — QLD 27/153/t
- Thalenessa lewisii* (Berkeley and Berkeley 1939) — fide Hartman 1959
as *Eusigalion hancocki* Hartman 1939
Rullier 1965 — QLD 27/153/i
- Willeysthenelais diplocirrus* (Grube 1875) — fide Pettibone 1971
- BM as *Sthenelais variabilis* var. *colorata* Monro 1924A — QLD 20/148/t

AMPHINOMIDAE

- BM *Amphinome jukesii* Baird 1868 — QLD 11/144/i
Monro 1924B — N.W. Australia
- lost *Amphinome nitida* Haswell 1878 — QLD 12/143/?
Amphinome rostrata (Pallas 1766)
Baird 1868 — Australia
Chloeia flava (Pallas 1788)
Baird 1868, Fauvel 1917, Augener 1922A, 1927A, 1933, Monro 1924B —
SA 34/138/?; QLD 10/143/?; 23/150/?; 19/146/t; 27/153/t
Chloeia flava var. *pulchella* (Baird 1868) — fide Hartman 1959
Fauvel 1917 — SA 34/138/?
- BM as *Chloeia puchella* (error for *pulchella*) Baird 1868 — QLD reefs
- BM as *Chloeia pulchella* var. *pallida* Baird 1868 — QLD 11/144/i
Chloeia flava tumida Baird 1868 — fide Hartman 1959
as *Chloeia tumida* Fauvel 1917 — "North Australia"
- ?BM *Chloeia fusca* McIntosh 1885
Monro 1924B — NT 9/129/t
- ?MNHN *Chloeia inermis* Quatrefages 1865 — "New Zealand"
Benham 1909, 1915A, 1916A, 1927, Augener 1924B, Monro 1936, Knox
1960A, 1965 — TAS 43/146/d; NZ 34/173/t; 35/173/o; 36/175/o;
41/174/?; 44/167/d; 45/170/d; 45/174/?; 47/169/t; Chatham Is.
43/177/vd; 43/178/vd; 43/179/d; 44/176W/d; Campbell Is. 52/169/?
- BM as *Chloeia spectabilis* Baird 1868 — "New Zealand"
- lost *Chloeia macleayi* Haswell 1878 — QLD 13/143/?
- HZM *Euphrosine maorica* Augener 1924B — NZ 34/172/o; 36/174/t; 36/175/o; 41/174/t
Monro 1936 — NZ 34/172/o
Euphrosine mastersii Haswell 1878 — QLD 10/143/t
- SSM *Eurythoe chilensis* Kinberg 1857
Monro 1939 — WA 35/118/o
Eurythoe complanata (Pallas 1766)
Baird 1868, Augener 1913, 1914, 1922A, 1927A, Benham 1921, Monro
1924B, 1931, Day 1975 — WA 19/118/i; 20/117/?; 25/113/i; 32/115/i, t;
TAS 42/148/? (doubtful); NSW 33/151/i; QLD 16/145/i
Eurythoe incarunculata (Peters 1854)
Augener 1922A — QLD 10/142/?
Eurythoe parvecarunculata Horst 1912
Stephenson et al., 1976 — QLD 27/153/t
Eurythoe cf. *parvecarunculata* Horst 1912
Stephenson et al., 1974 — QLD 27/153/t
Hipponoe gaudichaudii Audouin and Milne Edwards 1833
Quatrefages 1865, Baird 1868 — NSW 33/151/i

- lost *Notopygos flavus* Haswell 1878 — QLD 10/143/t
- BM *Notopygos hispidus* var. *serratus* Fauvel 1917 — SA 34/137/?; 34/138/?
- ?BM *Notopygos labiatus* McIntosh 1885
Benham 1915A, Monro 1939 — WA 35/118/?; SA 35/136/o
- lost *Notopygos parvus* Haswell 1878 — QLD (?locality)
Notopygos rayneri (Baird 1868) — fide Hartman 1959
- BM as *Lirione rayneri* Baird 1865 — QLD "reefs of N.E. Australia"
- HZM *Palmyreuphrosyne pacifica* Augener 1924B — NZ 34/172/o
- HZM *Pherecardites quinquemaculata* Augener 1927A — VIC 37/150/o
- CM *Pseudeurythoe minuta* Knox 1960A — Chatham Is. 43/177/vd; 43/176W/d
Pseudeurythoe oculifera (Augener 1913) — fide Hartman 1959
- HZM as *Paramphinome oculifera* Augener 1913 — WA 25/113/t; 32/115/i

PALMYRIDAE

- ?ZUW *Paleanotus chrysolepis* Schmarda 1861
Augener 1913, 1924B, Poore et al., 1975 — WA 25/113/t; 32/115/t; VIC 38/144/t; NZ 34/172/i
- Paleanotus occidentale* (Johnston 1897) — fide Day 1962
as *Chrysopetalum occidentale* Augener 1913, 1924A, 1924B, 1927A, Fyfe 1952 — WA 25/113/t; 32/115/i, t; 33/115/t; 35/117/t; NSW 33/151/i; NZ 34/172/o; 35/174/i; 36/174/t; Auckland Is. 50/166/i

SPINTHERIDAE

- HZM *Spinther australiensis* Augener 1913 — WA 33/115/t

PISIONIDAE

- Pisione oerstedii* Grube 1857
Augener 1924B — NZ 36/174/t
- (For *Dawbinia aucklandica* Benham 1950 — See Nereidae)

PHYLLODOCIDAE

- Anaitides longipes* (Kinberg 1866)
Poore et al., 1975 — VIC 38/144/t
- Eteone aurantiaca* Schmarda 1861
Knox 1960A — Chatham Is. 44/176W/t
- HZM *Eteone platycephala* Augener 1913 — WA 25/113/t
Augener 1924B, 1927B, Knox and Cameron 1971 — VIC 38/144/i; NZ 36/175/o; 37/176/t
- CM *Eulalia (Euphylla) benthicola* Knox 1960A — Chatham Is. 43/178/vd

- HZM *Eulalia (Pterocirrus) brevicornis* (Ehlers 1904)
as *Pterocirrus brevicornis* Ehlers 1904 — NZ 41/174/?
Ehlers 1905, 1907, Fauvel 1917 — SA 34/137/i; 34/138/?; NZ 40/173/t;
46/168/?
as *Steggoa brevicornis* Augener 1924A, 1924B, 1927A, 1927B — NSW
33/151/i; NZ 34/172/d; 37/176/t; 41/174/t; 47/169/o; Auckland
Is. 50/166/i
= *Eulalia (Pterocirus) magalaensis* Kinberg 1866 — fide Knox 1960A
Eulalia (Steggoa) capensis Schmarda 1861
as *Eulalia viridis* var. *capensis* Augener 1913, Knox 1960A — WA 25/113/t;
32/115/t; 33/115/t; Chatham Is. 43/175/o; 43/176W/d
- ?MNHN *Eulalia incompleta* Quatrefages 1865 — QLD 10/142/?
Eulalia (Pterocirrus) magalaensis Kinberg 1866B
Monro 1939, Knox 1960A, Knox and Cameron 1971 — TAS 43/147/i;
VIC 38/144/i; 38/145/i; Chatham Is. 43/177/vd; 44/176W/vd
as *Eulalia magalaensis* Ehlers 1907
Day 1975 — WA 32/115/t; NZ 43/169/?
- ?ZUA *Eulalia microphylla* Schmarda 1861 — "New Zealand (i)"
Augener 1913, 1924A, 1924B, 1927A, 1927B, 1932 — WA 25/113/t;
32/115/t; VIC 38/145/t; NZ 35/174/t; 36/174/i, t; 36/175/o; 36/176/t;
38/174/o; 39/173/t; 47/169/i, t; Auckland Is. 50/166/i, o
- ?MNHN as *Eulalia caeca* Quatrefages 1865 — "New Zealand"
as *Porroa microphylla* Quatrefages 1865 — record repeated
as *Carobia (Porroa) microphylla* Ehlers 1904, 1905, 1907 — NZ 40/173/i;
43/172/i; 44/168/i; 45/170/?; 45/166/?; Chatham Is. (?)
as *Eulalia novaezealandiae* Grube 1880 — New Zealand
- lost *Eulalia (Eumida) quadrocula* Haswell 1886 — NSW 33/151/t
Eulalia (Eumida) sanguinea Oersted 1843
Ehlers 1907, Knox 1960A — New Zealand; Chatham Is. 43/177/d, vd
Eulalia (Eumida) strigata Ehlers 1901
Augener 1913 — WA 25/113/t; 29/114/t; 32/115/t
Eulalia sp. Hutchings 1974 — NSW 32/152/e
Day 1975 — WA 32/115/t
- HZM *Mystides triangulifera* (Augener 1913) — fide Augener 1924B
Augener 1924B — NZ 36/175/o
as *Eteone triangulifera* Augener 1913 — WA 25/113/t; 29/114/t
Notophyllum imbricatum Moore 1906
Knox 1960A — Chatham Is. 43/179/d
- WAM *Phyllodoce (Anaitides) australis* Day 1975 — WA 32/115/t
Phyllodoce (Genetyllis) castanea (Marenzeller 1879)
Knox 1960A — Chatham Is. 43/177/vd; 43/178/vd

- HZM as *Carobia ochracea* Ehlers 1904 — NZ 43/172/t
Benham 1909 — NZ 39/177/t (or 45/171/t)
- as *Phyllodoce castanea* Augener 1913, 1924A, 1924B, 1927B, Knox 1951B
— WA 25/113/t; NZ 34/172/i; 37/176/t; 40/173/d; Campbell Is. 52/169/o
- BM *Phyllodoce duplex* McIntosh 1885 — NSW 36/150/d
Augener 1913, Knox and Cameron 1971, Hutchings 1974 — WA
25/113/t; 32/115/t; 35/117/t; VIC 38/144/t; NSW 32/152/e
as *Phyllodoce (Anaitides) duplex* Augener 1922B — WA 19/120/t
- Phyllodoce (Genetyllis) gracilis* Kinberg 1866B
Knox 1960A — Chatham Is. 43/175/o; 44/176W/t
- HZM as *Phyllodoce ovalifera* Augener 1913 — WA 25/113/t
Augener 1924A, 1924B, Benham 1927 — NZ 34/172/i; Auckland Is.
50/166/i
- Phyllodoce (Anaitides) madeirensis* Langerhans 1879
as *Phyllodoce (Anaitides) sanctijosephi* Gravier 1900, Augener 1924B,
1927A — NSW 33/151/i; NZ 34/172/o, d; 34/173/o, d
- Phyllodoce malmgreni* Gravier 1900
Monro 1931, Rullier 1965 — QLD 16/145/i, 27/153/i
- ? = *Phyllodoce novaehollandiae* Kinberg 1866 — fide Hartman 1959
- CM *Phyllodoce mernoensis* Knox 1960A — Chatham Is. 43/175/o
- SSM *Phyllodoce novaehollandiae* Kinberg 1866B — NSW 33/151/t
Augener 1922C — type checked
Hutchings and Recher 1974 — NSW 33/151/i
- Phyllodoce parvula* Gravier 1900
Augener 1913 — WA 25/113/t; 29/114/t
- ? = *Genetyllis castanea (Marenzeller)* — fide Hartman 1959
- Phyllodoce (Anaitides) patagonica* (Kinberg 1866B)
Monro 1936, Knox 1960A — NZ 34/172/o; Chatham Is. 43/177/vd;
43/176W/d
- as *Phyllodoce madeirensis* (non Langerhans) Benham 1927 — NZ 34/173/d
- HZM *Phyllodoce salicifolia* Augener 1913 — WA 25/113/t
- Phyllodoce (Anaitides) tenuissima* Grube 1878
Augener 1927A — VIC 38/149/d; NSW 37/150/o
- Phyllodoce* sp. Wood 1968 — NZ 36/174/i

ALCIOPIDAE

- Alciopa reynaudi* Krohn 1845
- ?BM as *Greefia oahuensis* McIntosh 1885
Benham 1929 — NZ 34/171/p; 34/172/p
- Alciopa* sp. Augener 1927A — NSW 35/?/p

Alciopina gazellae (Apstein 1893)

- BNM as *Corynocephalus gazellae* Apstein 1893 — WA 28/112/p
Naiades contrainii (Delle Chiaje 1828)
as *Alciopa contrainii* Benham 1929 — NZ 34/172/p

Torrea candida (Delle Chiaje 1841)

Benham 1929 — NZ 34/171/p; 34/172/p

Vanadis crystallina Greef 1876

- BM as *Vanadis augeneri* Benham 1929 — NZ 34/172/p; 34/173/p

Vanadis formosa Claparede 1870

as *Vanadis greeffiana* Grube 1878A — WA 17/119/p

- BNM *Vanadis studeri* Apstein 1893 — WA 28/112/p

Watelio gravieri (Benham 1929)

- BM as *Callizona gravieri* Benham 1929 — NZ 34/172/p

TYPHLOSCOLECIDAE

Sagitella kowalewskii Wagner 1872

Benham 1929 — NZ 34/172/p

TOMOPTERIDAE

- HZM *Tomopteris (Johnstonella) australiensis* Augener 1927A — VIC 38/149/p

Tomopteris elegans Chun 1887

Benham 1929 — NZ 34/172/p

- ?MNHN *Tomopteris huxleyi* Quatrefages 1865 — QLD 10/142/p
indeterminate — fide Hartman 1959

- KM *Tomopteris mortenseni* Augener 1927A — VIC 38/149/p

- ?MNHN *Tomopteris septentrionalis* Quatrefages 1865
Benham 1929 — NZ 34/172/p

HESIONIDAE

Hesione splendia Savigny 1820

Augener 1913, 1922B, Benham 1915A, Monro 1931 — WA 19/120/t;
25/113/t; VIC 39/148/d; QLD 27/153/t

as *Hesione genetta* Grube 1866 — fide Day 1962
Monro 1931 — QLD 16/145/?

as *Hesione intertexta* Grube 1878 — fide Day 1962

Monro 1926, 1931 — QLD 10/143/t; 14/144/t; 14/145/t; 16/145/?;
20/149/t

as *Hesione pantherina* Risso 1826 — fide Day 1962

Fauvel 1922 — WA 28/113/t

?as *Hesione eugeniae* Kinberg 1857

Monro 1926 — QLD 10/142/o

- Leocrates chinensis* Kinberg 1866
 Augener 1922B, Monro 1931 — WA 19/120/t; QLD 14/145/t
 ?as *Leocrates* cf. *claparedii* Stephenson et al., 1974 — QLD 27/153/t
- CM *Nereimyra blacki* Knox 1960A — Chatham Is. 44/176W/d
 = *Parasyllidea blacki* — fide Pettibone 1961
- Nereimyra crinita* (Haswell 1886)
- lost as *Psamathe*? *crinita* Haswell 1886 — NSW 33/151/t
- NMV *Nereimyra longicirrata* Knox and Cameron 1971 — VIC 38/144/t
- Ophiodromus angustifrons* (Grube 1878)
 as *Podarke angustifrons* Augener 1924A, 1924B, 1927A, Knox 1960A, 1965
 — NSW 33/151/i,t; 37/150/o; NZ 35/174/t; 36/174/t; 39/173/t; 41/173/t;
 43/172/t; 44/167/t; 47/169/t; Chatham Is. 42/175W/t; 43/176W/i;
 Auckland Is. 50/166/i
- as *Irma angustifrons* Grube 1878
 Ehlers 1907, Augener 1913 — WA 25/113/p; NZ 43/169/?
- Ophiodromus latifrons* (Grube 1878)
 as *Irma latifrons* Grube 1878
 Monro 1926 — NSW 33/151/?

PILARGIDAE

- CM *Ancistrostylis* sp. Knox 1965 — NZ 44/167/d
 Pilargidae — 3 spp. — Stephenson et al., 1974, Poore et al., 1975 —
 VIC 38/144/t; QLD 27/153/t

SYLLIDAE

- Amblyosyllis brevicornis* (Ehlers 1904)
 as *Pterosyllis brevicornis* Ehlers 1904 — NZ 40/173/?
- Amblyosyllis formosa* Claparede 1863
 as *Amblyosyllis spectabilis* (Johnston 1865)
 Haswell 1920A — NSW 33/151/t
- Amblyosyllis granosa* Ehlers 1897
 Augener 1913, 1924A, 1924B, Monro 1936 — WA 25/113/t; NZ
 34/172/o; 35/174/i; 36/175/o; Auckland Is. 50/166/i
- Autolytus* cf. *afer* Ehlers 1908
 Augener 1913 — WA 25/113/p
- Autolytus charcoti* Gravier 1906
 Knox and Cameron 1970 — NZ 48/166/i
- CM *Autolytus chathamensis* Knox 1960A — Chatham Is. 42/176W/i; 44/176W/p
- Autolytus* (*Proceraea*) *fasciata* Langerhans 1879 (Homonym)
 Augener 1913 — WA 25/113/t; 29/114/t

- BM *Autolytus maclearnus* McIntosh 1885
Augener 1924A, Knox 1960A — Chatham Is. 42/176W/i; Auckland Is. 50/166/i
- Autolytus monoceros* (Ehlers 1907)
Augener 1924A, 1924B — NZ 34/172/i; 36/175/o; Auckland Is. 50/166/i
as *Pterautolytus monoceros* Ehlers 1907 — NZ 45/170/?
- Autolytus pictus* Ehlers 1864
as *Autolytus (Proceraea) picta* Augener 1913 — WA 25/113/t; 29/114/t; 35/117/t
- HZM *Autolytus spirifer* Augener 1913 — WA 25/113/t
Brania furcelligera (Augener 1913)
- HZM as *Grubea furcelligera* Augener 1913 — WA 29/114/t
Augener 1924 — NZ 42/173/?; 47/169/t
- Brania kerguelensis* (McIntosh 1885) — fide Knox 1960A
Knox 1960A — Chatham Is. 42/175W/t; 43/176W/t
- BM as *Salvatoria kerguelensis* McIntosh 1885
- as *Grubea kerguelensis* Augener 1913, Haswell 1920B — WA 25/113/t; 29/114/t; 32/115/i, t; 35/117/t; NSW 33/151/i
- as *Grubeosyllis kerguelensis* Augener 1924A, 1924B, 1927A — NSW 33/151/i; NZ 34/172/i, o, d; 35/174/i; 36/175/o; Auckland Is. 50/166/i
- AM *Brania pusilloides* (Haswell 1920)
as *Grubea pusilloides* Haswell 1920B — NSW 33/151/i
- HZM *Brania quadrioculata* (Augener 1913)
as *Grubea quadrioculata* Augener 1913 — WA 25/113/t; 29/114/t
Haswell 1920B — NSW 33/151/i
- Brania rhopalophora* (Ehlers 1897)
Knox and Cameron 1970, Poore et al., 1975 — VIC 38/144/t; NZ 48/166/i
- CM *Clavisyllis alternata* Knox 1957 — NZ 43/172/i
- CM *Eudontosyllis aciculata* Knox 1960A — Chatham Is. 44/176W/t
- Eurysyllis tuberculata* Ehlers 1864
Augener 1913, Haswell 1920A — WA 25/113/i; 32/115/i; 35/117/t; NSW 33/151/i
- NMV *Eusyllis brevicirrata* Knox and Cameron 1971 — VIC 38/114/i, t
- Eusyllis inflata* (Marenzeller) — fide Imajima 1966
- AM as *Syllis kinbergiana* Haswell 1886 — NSW 33/151/i (not Augener 1913 or Fauvel 1917)
- as *Syllis (Typosyllis) kinbergiana* Haswell 1920A — NSW 33/151/i
- ?as *Syllis (Typosyllis) kinbergiana* Knox and Cameron 1971 — VIC 38/145/i

- BM *Eusyllis kerguelensis* McIntosh 1885
Augener 1924B, 1927A, 1927B, 1932, Knox 1960A — NZ 34/172/d;
36/174/t; 36/175/o; 36/176/t; 37/177/d; 39/173/t; Chatham Is. 43/179/d;
Campbell Is. 52/169/i
 ?as *Eusyllis cf. kerguelensis* Pope 1943 — NSW 33/151/i
- AM *Exogone fustifera* Haswell 1920B — NSW 32/151/i; 33/151/i
Exogone gemmifera Pagenstecher 1862
 Poore et al., 1975 — VIC 38/144/t
- lost *Exogone heterosetosa* McIntosh 1885
 Haswell 1920B, Knox 1960A — NSW 33/151/i; Chatham Is. 44/176W/i
Exogone verugera (Claparede 1868)
 Haswell 1920B — NSW 33/151/i
 as *Exogone heterochaeta* (non McIntosh) Augener 1913, ?1924A, ?1924B,
 ?1927A — WA 25/113/t; 29/114/t; 32/114/t; 33/115/t; 35/117/t; VIC
 38/149/o; ?NSW 33/151/i; NZ 34/172/i, o, d; 35/174/i; 36/174/t; 47/169/t;
 Auckland Is. 50/166/i
Langerhansia cornuta (Rathke 1843)
 Poore et al., 1975 — VIC 38/144/t
Myrianida pachycera (Augener 1913) — fide Imajima 1966
 Hartman 1966 — NSW 33/151/t
- HZM as *Autolytus pachycerus* Augener 1913 — WA 25/113/t; 32/115/t; 35/117/t
- CM *Nudisyllis tiniheka* Knox and Cameron 1970 — NZ 48/166/i
- HZM *Odontosyllis detecta* Augener 1913 — WA 25/113/t
 Haswell 1920A, Augener 1927A — NSW 33/151/i
- HZM *Odontosyllis freycinetensis* Augener 1913 — WA 25/113/e, i
 Haswell 1920A — NSW 33/151/i
Odontosyllis fulgurans (Audouin and Milne Edwards 1883)
 Thomson 1946 — WA 32/115/e
- HZM *Odontosyllis glandulosa* Augener 1913 — WA 25/113/t
Odontosyllis hyalina Grube 1878
 Monro 1931 — QLD 16/145/i
- CM *Odontosyllis maorioria* Knox 1960A — Chatham Is. 43/176/t
 Knox and Cameron 1970 — NZ 48/166/i
Odontosyllis polycera (Schmarda 1861)
 Augener 1924B, 1927A, Knox 1960A — NSW 33/151/i; NZ 34/172/o;
 36/174/i; 36/175/o; 43/172/?i; Chatham Is. 43/176W/t, o; 44/176W/i
- SSM ?as *Eurymedusa picta* Kingerg 1866B — NSW 33/151/i
 Ehlers 1904, 1907 — NZ 41/172/?; 43/172/i
- OM ?as *Odontosyllis suteri* Benham 1915B, Haswell 1920A — NSW 33/151/i;
 NZ 45/170/i; 47/169/i

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- KM *Odontosyllis psammochroma* Augener 1924B — NZ 36/174/i
- HZM *Opisthosyllis australis* Augener 1913, 1914, 1924B — WA 25/113/i, t; 32/115/i; 35/117/t; NZ 34/172/i; 35/174/i
- ?ZUW ?as *Syllis macrura* Schmarda 1861 — NZ (?locality)
- ?MNHN ?as *Sphaerosyllis macrura* Quatrefages 1865 — record repeated
- Opisthosyllis brunnea* Langerhans 1879
Day 1975 — WA 32/115/t
- Pionosyllis comosa* Gravier 1906
Monro 1936, Pope 1943, Knox 1960A — ?NSW 33/151/t; NZ 34/172/o;
Chatham Is. 42/176W/i; 43/176W/t; 43/178/vd; 44/175W/d
- Pionosyllis divaricata* (Keferstein 1862)
Haswell 1920B — NSW 33/151/i
- HZM *Pionosyllis ehlersiaeformis* Augener 1913 — WA 25/113/p, t
Knox 1960A — Chatham Is. 43/176W/t; 44/175W/d
- HZM *Pionosyllis fusigera* Augener 1913 — WA 25/113/t
- AM *Pionosyllis melaenonephra* Haswell 1920B — NSW 33/151/i
- BM *Pionosyllis nutrix* Monro 1936
Knox and Cameron 1970 — NZ 48/166/i
- Pionosyllis pulligera* (Krohn 1852)
Augener 1913 — WA 25/113/t; 32/115/p
- Pionosyllis stylifera* Ehlers 1913
Augener 1924A, 1924B, Knox 1960A — NZ 34/172/o; 35/174/t; 36/174/t;
36/175/i, o; 38/174/o; 39/173/t; 39/177/i; Chatham Is. 42/176W/i;
Auckland Is. 50/166/i
- HZM *Pionosyllis weissmannioides* Augener 1913 — WA 25/113/t
Augener 1924B — ?NZ 36/175/o
- HZM *Rhopalosyllis hamulifera* Augener 1913 — WA 25/113/t
- Sphaerosyllis hirsuta* Ehlers 1897
Augener 1913, 1924A, 1924B, 1927A, Fauvel 1917, Haswell 1920B,
Knox 1960A — WA 25/113/t; 29/114/t; 32/115/t; SA 34/137/?; 34/138/?;
NSW 33/151/i; NZ 34/172/i, o, d; 35/174/i; 36/174/t; 36/175/o; Chatham
Is. 42/176W/i; Auckland Is. 50/166/i
- Sphaerosyllis hystrix* Claparède 1863
Haswell 1920B — NSW 33/151/i
- Sphaerosyllis perspicax* Ehlers 1908
Augener 1913, 1924A, 1927A, Haswell 1920B — WA 25/113/t; 29/114/t;
32/115/t; 35/117/t; NSW 33/151/i; Auckland Is. 50/166/i
- Syllides longocirrata* Oersted 1845
Augener 1913, 1924A, Haswell 1920A, Poore et al., 1975 — WA
25/113/t; VIC 38/144/t; NSW 33/151/i; Auckland Is. 50/166/i

- Syllis gracilis* Grube 1840
 Haswell 1920A, Augener 1927A — NSW 33/151/i
 as *Syllis longissima* Fauvel 1917 — fide Augener 1927A — SA 34/138/?
- Syllis longissima* Gravier 1900
 Fauvel 1917 — SA 34/138/?
 as *Syllis gracilis* (non Grube) Augener 1913 — fide Fauvel 1917 — WA 25/113/t; 32/115/i; 35/117/t
- Syllis (Haplosyllis) spongicola* Grube 1855
 Haswell 1920A — NSW 33/151/i
 as *Haplosyllis spongicola* Augener 1924A, 1924B, 1927A, 1927B, Knox 1960A — VIC 38/148/d; 38/149/d; NSW 37/149/o; NZ 34/172/o, d; 36/175/o; 37/176/t; 37/177/d; 39/173/t; Chatham Is. 43/176W/o; Auckland Is. 50/166/i
 as *Syllis (Haplosyllis) Djiboutiensis* Gravier 1900, Augener 1913 — WA 25/113/t; 29/114/t; 32/115/i
- Syllis (Langerhansia) anops* (Ehlers 1897)
 as *Syllis (Ehlersia) anops* Knox 1960A — Chatham Is. 43/178/vd
- Syllis (Langerhansia) ferrugina* (Langerhans 1881)
 Augener 1913 — WA 25/113/t; 33/115/t
 as *Syllis (Ehlersia) ferruginea* Haswell 1920A, Augener 1924B, 1927A — NSW 33/151/i; 37/150/o; NZ 34/172/d; 36/174/t
- Syllis (Typosyllis) armillaris* Müller 1771
 Knox 1960A — Chatham Is. 43/176W/t
- ?ZUW as *Syllis brachychaeta* Schmarda 1861 — fide Day 1967
 Augener 1924A, 1924B, 1927A, Knox 1951B — NSW 37/150/o; NZ 34/172/i, o, d; 35/174/?; 36/174/i; 39/173/t; 40/173/d; Campbell Is. 52/169/i; Auckland Is. 50/166/i
 as *Syllis closterobranchia* Schmarda 1861 — fide Day 1967
 Ehlers 1904, 1905, 1907, Augener 1913, Haswell 1920A, Pope 1943 — WA 25/113/t; 29/114/t; 32/115/t; 35/117/t; NSW 33/151/i; NZ 43/172/?; 46/168/?; Campbell Is. 52/169/?
- as *Syllis (Typosyllis) kinbergiana* (non Haswell)
 Augener 1913, Fauvel 1917, Knox and Cameron 1971 — WA 25/113/t; 29/114/t; 32/115/i, t; 33/115/t; 35/117/t; SA 34/138/?; VIC 38/145/i
 as *Syllis closterobranchia* var. *kinbergiana* Pope 1943 — NSW 33/151/t
- AM as *Syllis (Typosyllis) augeneri* Haswell 1920A — NSW 33/151/i
 Knox 1960A, Knox and Cameron 1970 — NZ 48/166/i; Chatham Is. 43/176W/o
 as *Syllis hyalina* (non Grube)
 Fauvel 1917 — SA 34/138/?
- CM *Syllis (Typosyllis) attenuata* Knox 1960A — Chatham Is. 43/175/o
Syllis (Typosyllis) brachycola Ehlers 1897
 Augener 1924A, 1924B, 1932, Benham 1927, Knox 1960A — NZ 34/172/i, o, d, p; 34/173/d; 35/174/i; 36/174/i; 36/175/o; 39/173/t;

- Chatham Is. 43/176W/i; Auckland Is 50/166/i; Campbell Is. 52/169/i
as *Syllis brachyola* (sic) Knox 1951B — NZ 40/173/d
- Syllis* (*Typosyllis*) *cirropunctata* Michel 1909
Day 1975 — WA 32/115/t
- AM *Syllis* (*Typosyllis*) *corruscans* Haswell 1886 — NSW 33/151/i, t
Augener 1913, Haswell 1920A, Knox 1960A — WA 25/113/t; 29/114/t;
NSW 33/151/i; Chatham Is. 44/176W/i
- Syllis* (*Typosyllis*) *exilis* Gravier 1900
Augener 1913, Fauvel 1917 — WA 25/113/t; 29/114/t; 32/115/t; 35/117/t;
SA 34/137/?; 34/138/?
- Syllis* (*Typosyllis*) *hyalina* Grube 1863
Rullier 1965 — QLD 27/153/i
- AM *Syllis* (*Typosyllis*) *parturiens* Haswell 1920A — NSW 33/151/i
- AM *Syllis* (*Typosyllis*) *pectinans* Haswell 1920A — NSW 33/151/i
- Syllis* (*Typosyllis*) *prolifera* var. *zonata* (Haswell 1886) — fide Day 1967
Knox 1960A — Chatham Is. 43/176W/t
- lost as *Gnathosyllis zonata* Haswell 1886 — NSW 33/151/i
as *Syllis* (*Typosyllis*) *zonata* Augener 1913 — WA 25/113/i
as *Syllis zonata* Pope 1943 — NSW 33/151/i, t
- AM *Syllis* (*Typosyllis*) *punctulata* Haswell 1920A — NSW 33/151/i; 34/151/i
- Syllis* (*Typosyllis*) *regulata* Imaijima 1966
as *Syllis* (*Langerhansia*) *cerina* (non Grube) Augener 1913 — WA 25/113/t;
32/115/t; 35/117/t
as *Syllis* (*Ehlersia*) *cerina* (non Grube) Augener 1924B — NZ 34/172/d;
34/173/i; 36/174/t; 38/174/o; 39/173/t; 45/170/?
- AM *Syllis* (*Typosyllis*) *truncata* Haswell 1920A — NSW 32/152/i;
33/151/i
- Syllis* (*Typosyllis*) *tristanensis* Day 1954
Knox 1960A — Chatham Is. 43/175/o; 43/176W/i; 44/176W/t
- Syllis* (*Typosyllis*) *variegata* Grube 1860
Augener 1913, 1922B, 1924B, 1927A, Haswell 1920A, Pope 1943, Knox
1951B, 1960A — WA 17/121/i; 19/120/t; 25/113/t; 32/115/t; 33/115/t;
35/117/t; NSW 33/151/i; NZ 34/173/d; 40/173/d; Chatham Is. 43/175/o;
42/175W/i; 44/175W/d; 44/176W/o
- lost as *Syllis nigropunctata* Haswell 1886 — NSW 33/151/i
- lost as *Syllis schmardiana* Haswell 1886 — NSW 33/151/i
- lost? as *Thoe fusiformis* Kinberg 1866B — NSW 33/151/i
- HZM *Syllis* (*Typosyllis*) *verruculosa* Augener 1913 — WA 25/113/t; 35/117/t
Syllis sp. *Monro* 1939 — VIC 38/144/i
Syllis sp. *A.* Day 1975 — WA 32/115/t
Syllis sp. *B.* Day 1975 — WA 32/115/t

- HZM *Trypanosyllis (Trypanobia) depressa* Augener 1913 — fide Imajima 1966
as *Haplosyllis depressa* Augener 1913 — WA 25/113/t
- Trypanosyllis gigantea* (McIntosh 1885)
Fauvel 1917, Augener 1924B, 1927A, 1927B, Knox 1951B — SA 34/138/?; VIC 38/149/d; NZ 34/172/o, d; 34/173/d; 36/174/i, t; 36/175/o; 36/177/d; 37/176/t; 40/173/d
- Trypanosyllis (Trypanodentata) taeniaeformis* (Haswell 1886) — fide Imajima 1966
- lost as *Syllis taeniaeformis* Haswell 1886 — NSW 33/151/t
- as *Trypanosyllis taeniaeformis* Augener 1913, Monro 1936, 1939, Knox 1960A — WA 25/113/t; 29/114/t; 32/115/t; 35/117/t; 35/118/o; NZ 34/172/o; Chatham Is. 43/176W/o; 44/176W/t, o
- Trypanosyllis zebra* (Grube 1860)
Haswell 1920A, Knox and Cameron 1971, Poore et al., 1975 — NSW 33/151/i; VIC 38/145/i; 38/144/t

NEREIDAE

- Australonereis ehlersi* (Augener 1913)
Hartman 1954, Russell 1962, Hutchings 1974, Hutchings and Recher 1974 — VIC 38/148/e; NSW 32/152/e; 33/151/i; QLD 27/153/t
- HZM as *Nereis (Leonnates) ehlersi* Augener 1913 — WA 32/115/e
as *Leonnates ehlersi* Monro 1938, Kott 1951 — WA 32/115/e
- Ceratocephala sibogae* Horst 1924
Stephenson et al., 1974 — QLD 27/153/t
- HZM *Ceratonereis aquisetis* Augener 1913 — WA 32/115/e
as *Nereis aquiseta* Kott 1951 — record repeated
- Ceratonereis costae* (Grube 1840)
Knox and Cameron 1971 — VIC 38/144/i, t
as *Nereis (Ceratonereis) costae* Kott 1951 — WA 31/115/i
- Ceratonereis erythraeensis* Fauvel 1919
Monro 1938, Thomson 1946, Hartman 1954, Russell 1962, Hutchings and Recher 1974, Poore et al., 1975 — WA 32/115/e; VIC 38/144/t; NSW 33/151/i; QLD 27/153/e
- as *Nereis (Ceratonereis) erythraeensis* Kott 1951 — WA 31/115/i
- as *Nereis (Hediste) diversicolor* (non Müller) — fide Hutchings, pers. comm.
- Hutchings 1974, Hutchings and Recher 1974 — NSW 32/152/e; 33/151/i
- Ceratonereis lapinigenis* Grube 1878
Augener 1913, Hartman 1954 — WA 25/113/t; 32/115/t; 33/115/t; SA 35/138/i; VIC 38/148/i; NSW 34/150/i
- as *Nereis lapinigenis* Kott 1951 — WA 32/115/i
- ? = *Ceratonereis costae* — fide Hartman 1959

- Ceratonereis mirabilis* Kinberg 1866
 Fauvel 1917, Hartman 1954, Russell 1962, Rullier 1965, Knox and Cameron 1971, Hutchings 1974 — SA 34/136/t; 34/137/?; 34/138/?; VIC 38/144/i, t; NSW 32/152/e; QLD 27/153/i; "Barrier Reef"
- as *Ceratonereis tentaculata* Kinberg 1866
 Augener 1913, Monro 1931 — WA 25/113/t; 32/115/e; 33/115/t; QLD 14/145/t
- as *Nereis tentaculata* Kott 1951 — WA 32/115/i
- OM *Cheilonereis peristomialis* Benham 1916B — SA 35/129/d
 Benham 1927, Hartman 1954, Knox 1951A — NZ 34/173/t; Chatham Is. 43/179/d; 44/176W/vd
- OM *Dawbinia aucklandica* Benham 1950 — Auckland Is. 50/166/i
 (Referred to Pisionidae by Benham 1950)
- AM *Leonnates stephensoni* Rullier 1965 — QLD 27/153/t
- AHM *Micronereis halei* Hartman 1954 — SA 35/138/i — see note added in press.
- Namalycastis abiuma* (Grube 1871)
 Russell 1962 — QLD 27/153/e
- NZOI *Namalycastis tiriteae* Winterbourn 1969 — NZ 45/170/fw
- Namanereis quadraticeps* (Blanchard 1849)
 Hartman 1954, Winterbourn 1969, Knox and Cameron 1970 — NZ 45/170/i; 48/166/i
- as *Lycastis quadraticeps* Augener 1924A — Auckland Is. 50/166/i; Campbell Is. 52/169/i
- as *Lycastis quadriceps* (sic) Benham 1950 — Auckland Is. 50/166/i
- BM *Nereis (Eunereis) marri* Monro 1939 — WA 35/118/o
- Nereis (Neanthes) sp.* Augener 1913 — fide Hartman 1954
 as *Nereis angusticollis* (non Kinberg) Augener 1913 — WA 25/113/t
- Nereis (Neanthes) articulata* Knox 1960
- CM as *Neanthes articulata* Knox 1960A — Chatham Is. 43/176W/t
- Nereis (Neanthes) caudata* Delle Chiaje 1841
 Knox and Cameron 1971 — VIC 38/144/t
- HZM *Nereis (Neanthes) cricognatha* Ehlers 1904 — Chatham Is. (?)
 Kott 1951 — WA 32/115/e, i
- as *Nereis cricognatha* Ehlers 1905, 1907, Augener 1913, 1924B, 1927A, 1927B, Monro 1936 — WA 25/113/t; NSW 37/150/o; NZ 34/172/o; 36/175/o; Chatham Is. 44/176W/d
- as *Neanthes cricognatha* Knox 1951A, 1960A, Hartman 1954 — SA 36/137/i; 35/148/t; 35/138/t; NZ 36/175/i; 37/176/i
- as *Nereis arenaceodentata* (non Moore) Benham 1916B — VIC 39/148/i

- Nereis (Neanthes) glandicincta* Southern 1921
as *Nereis glandicincta* Rullier 1965 — QLD 27/153/t
- BM *Nereis (Neanthes) kerguelensis* McIntosh 1885
as *Nereis kerguelensis* Ehlers 1907, Fauvel 1917, Benham 1916B, Augener 1924B, 1927A, 1927B — SA 34/138/?; TAS 40/145/d; VIC 38/149/d; NSW 33/151/i; 37/150/o; NZ 37/176/t; 45/170/?; 47/169/o
as *Neanthes kerguelensis* Hartman 1954 — SA 35/138/i
- HZM as *Nereis kerguelensis* var. *oligodonta* Augener 1913 — WA 32/115/t
- Nereis (Neanthes) oxypoda* Marenzeller 1879
as *Nereis oxypoda* Monro 1938, Thomson 1946, Kott 1951 — WA 32/115/e
as *Neanthes oxypoda* Hartman 1954 — record repeated
- Nereis (Neanthes) ruficeps* Ehlers 1904
as *Nereis ruficeps* Ehlers 1904, 1905, 1907 — NZ 43/172/?; Chatham Is. (i)
- Nereis (Neanthes) uncinula* Russell 1962
- lost *Neanthes uncinula* Russell 1962 — QLD 27/153/i
as *Nereis uncinula* Rullier 1965 — QLD 27/153/i
- Nereis (Neanthes) unifasciata* Willey 1905
as *Nereis unifasciata* Monro 1931 — QLD 16/145/i
- SSM *Nereis (Neanthes) vaalii* (Kinberg 1866A) — NSW 33/151/i
Day 1975 — WA 32/115/i, t, p
as *Neanthes vaalii* Kinberg 1866A, Hartman 1954, Hutchings and Recher 1974 — SA 34/138/i; 35/137/i; TAS 41/145/i; NSW 33/151/i
as *Nereis vaali* Augener 1922A, 1924B, Monro 1931 — TAS 43/147/e; NSW 33/151/i; NZ 34/172/i
- HZM as *Nereis albanyensis* Augener 1913 — WA 32/115/t, 35/117/i; fide Augener 1924
Monro 1926, Thomson 1946 — WA 32/116/i; NSW 33/151/i
as *Nereis (Neanthes) albanyensis* Fauvel 1917 — SA 33/134/?; 34/138/?
as *Nereis (Neanthes) albanyensis* (non Augener) — fide Hartman 1954
Kott 1951 — WA 32/115/e, i
- CM, BM *Nereis (Nereis) antipoda* Knox 1960A — Chatham Is. 44/176W/p
- HZM *Nereis (Nereis) cockburnensis* Augener 1913 — WA 25/113/?
Hartman 1954, Knox and Cameron 1971, Day 1975 — WA 32/115/t; SA 35/148/i; 36/137/i; 35/138/i; VIC 38/144/t; NSW 33/151/i
- CM *Nereis (Nereis) delli* Knox 1960A — Chatham Is. 45/178W/d
- Nereis (Nereis) falcaria* Willey 1905
Benham 1927, Knox 1951A, 1960A, Knox and Cameron 1970 — NZ 34/172/o; 39/174/t; 43/172/i; 45/170/i; 48/166/i; Chatham Is. 43/176W/i, t; 44/176W/p, t

- HZM as *Nereis mortenseni* Augener 1924A, 1924B, 1927B — NZ 34/173/i; 35/174/i; 36/174/t; 36/175/i, o; 37/175/i; 37/176/t, o; 37/177/d; 39/173/t; 43/172/t; 45/170/?; Auckland Is. 50/166/i, o
- SSM *Nereis (Nereis) jacksoni* Kinberg 1866B — NSW 33/151/i
Augener 1922B, 1924B, 1927A, Monro 1936, 1939, Kott 1951, Knox 1951A, 1960A, Hartman 1954, Rullier 1965, Knox and Cameron 1971 — WA 19/120/t; 32/115/i; TAS 43/173/e; VIC 38/145/t; NSW 33/151/e, t, o; 37/150/o; QLD 27/153/i, t; NZ 34/172/o; 43/172/i; 47/169/i, o; 48/166/i; Chatham Is. 43/176W/o; 44/176W/i
- HZM as *Nereis (Nereis) denhamensis* Augener 1913 — WA 25/113/i
Fauvel 1917, 1922, Kott 1951, Hartman 1954 — WA 28/113/i; 32/115/i; SA (?locality)
- HZM as *Nereis heirissonensis* Augener 1913 — WA 25/113/t; 29/114/t
as *Ceratonereis falcaria* (non Willey) Benham 1916B — SA 36/137/o
Nereis (Nereis) pelagica Linnaeus var. Pope 1943 — NSW 33/151/i
- AM *Nereis (Nereis) peroniensis* (Kott 1951) — WA 32/115/i — fide Hartman 1954
as *Nereis calloana* Grube var. *peroniensis* Kott 1951 — WA 32/115/i
- ?MNHN *Nereis (Nereis) robusta* Quatrefages 1865 — NZ (?indeterminable)
Nereis (Nereis) semperiana Grube 1878
Augener 1922B — WA 19/120/t
Nereis (Nereis) thompsoni Kott 1951
Russell 1962 — QLD 27/153/i
- AM as *Nereis (Neanthes) thompsoni* Kott 1951 — WA 32/115/i
Nereis (Nereis) persica Fauvel 1911
as *Nereis zonata - persica* Pope 1943 — NSW 33/151/t
- BM *Nicon aestuariensis* Knox 1951A — NZ 43/172/e
Estcourt 1966A — NZ 43/172/e
- AHM *Olganereis edmonsi* (Hartman 1954), new combination, Hartman-Schröder 1977
as *Ceratocephale edmondsi* Hartman 1954 — SA 36/137/i
Perinereis aibuhitensis Grube 1878
Russell 1962 — QLD 27/153/i
Perinereis amblyodonta (Schmarda 1861)
Augener 1913, Monro 1926, Kott 1951, Hartman 1954, Knox 1960A, Russell 1962, Knox and Cameron 1971 — WA 32/115/i; 35/117/i; SA 35/137/i; 35/138/i; VIC 38/144/i; NSW 33/151/i, t; QLD 27/153/i; Chatham Is. 43/176W/i, p; 44/175W/i; 44/176W/i
- ?ZUW as *Nereilepas amblyodonta* Schmarda 1861 — NSW 33/151/i
as *Nereis amblyodonta* Ehlers 1904, 1905, 1907, Benham 1909 — NZ 36/174/?; 40/173/?; Chatham Is. 43/176/i
- SSM as *Perinereis novaehollandiae* Kinberg 1866B — NSW 33/151/t
Augener 1924B, 1927A, Pope 1943, Knox 1951A — NSW 33/151/i, t; NZ 34/172/i; 35/174/i; 36/174/i; 37/175/i; 41/174/i; 43/172/i; 47/169/i

- BM *Perinereis barbara* Monro 1926 — NSW 33/151/?
- BM *Perinereis calmani* Monro 1926 — NSW 33/151/i
Russell 1962 — QLD 27/153/i
- Perinereis camiguina* Grube 1878
Augener 1922A, Monro 1931 — QLD 10/142/?; 16/145/i; 18/146/i
- Perinereis camiguinoides* Augener 1922
Augener 1924B, 1927B, Knox 1951A — NZ 34/172/i; 35/174/i; 36/174/i;
37/176/t; 43/172/i, t
as *Nereis vancaurica* (non Kinberg) Ehlers 1904, 1905 — NZ 36/174/?;
40/173/?; 43/172/i
- Perinereis helleri* Grube 1878
Monro 1931, Russell 1962 — QLD 16/145/?; 23/152/i, p
- Perinereis nigropunctata* (Horst 1889)
Monro 1931 — QLD 16/145/i
- lost as *Perinereis yorkensis* Augener 1922A — QLD 10/142/?
- Perinereis nuntia brevicirris* (Grube 1857)
Knox 1951A, 1960A, Estcourt 1967, Knox and Cameron 1971 — VIC
38/144/t; NZ 43/172/e, i; Chatham Is. 43/176W/i; 44/176W/i
as *Perinereis brevicirrus* (sic) Russell 1962 — QLD 27/153/i
- HZM as *Perinereis heterodonta* var. *mictodontoides* Augener 1913, 1922A —
WA 25/113/i; NSW 33/151/i; QLD 10/142/?
- Perinereis nuntia vallata* (Grube 1857)
Monro 1926, Knox 1951A, 1960A, Estcourt 1967 — NSW 33/151/i; NZ
43/172/e, i; Chatham Is. 42/176W/i; 44/176W/i
as *Nereis vallata* Grube 1857
Ehlers 1904, 1905, 1907, Benham 1909 — NZ 40/173/i; 42/173/?;
43/172/?; 45/170/?
as *Nereis* (*Perinereis*) *vallata* Augener 1913, 1924A, 1924B, 1927B, 1932,
Hartman 1954 — WA 35/117/i; SA 35/138/?; NZ 34/173/i; 35/174/i;
36/174/i; 41/174/i; 43/172/i; 47/169/i; Auckland Is. 50/166/i; Campbell
Is. 52/169/i
- Perinereis obfuscata* Grube 1878
Monro 1931 — QLD 16/145/i
- HZM *Perinereis ponuiensis* Augener 1924B — NZ 34/173/i; 35/174/i; 36/174/i; 36/175/i
- Perinereis pseudocamiguina* Augener 1922
Augener 1924B, Monro 1939 — TAS 43/147/i; NZ 34/172/i; 34/173/i;
35/174/i; 36/174/i
- Perinereis vancaurica* (Ehlers 1864)
Augener 1922A, Monro 1932, Russell 1962 — QLD 10/142/?; 16/145/?;
27/153/i
as *Nereis vancaurica* Ehlers 1904 — NZ 36/174/?; 43/172/?

- lost ?as *Nereis languida* Kinberg 1866B — NSW 33/151/t
- HZM *Perinereis variodentata* Augener 1913 — WA 35/117/t
 Kott 1951, Hartman 1954 — WA 32/115/i; SA 35/138/i; TAS 41/144/i
- Platynereis australis* (Schmarda 1861)
 Knox 1951A, 1951B, 1960A, 1965, Estcourt 1967, Knox and Cameron
 1970, 1971, Day 1975 — WA 32/115/i, t, p; VIC 38/144/i, t; 38/145/t; NZ
 36/174/i; 40/173/d; 43/172/e, i; 48/166/i; Chatham Is. 42/176W/i;
 43/176W/i; 44/176W/ p, d; 44/177W/d
- ?ZUW as *Heteronereis australis* Schmarda 1861 — NZ 36/174/?
 as *Nereis australis* Ehlers 1904, 1905, 1907, Benham 1909, 1950 — NZ
 36/174/i; 43/172/i; 45/170/i; Auckland Is. 50/166/i; Campbell Is.
 52/169/?
- as *Nereis (Platynereis) australis* Augener 1924A, 1924B, 1927B, 1932 — NZ
 34/172/i; 34/173/i; 36/174/i; 36/176/t, o; 39/173/t; 39/177/i; 41/174/t;
 43/172/i, t; Auckland Is. 50/166/i; Campbell Is. 52/169/i
- as *Platynereis magalhaensis* Kinberg 1866B
 Fauvel 1917, Hartman 1954 — SA 32/133/?; 35/138/i
- Platynereis bicanaliculata* (Baird 1863)
 Hartman 1954 — NSW 33/151/t
- as *Nereis (Platynereis) agassizi* Ehlers 1868
 Augener 1927A — NSW 33/151/t
- Platynereis dumerilii* (Audouin and Milne Edwards 1833)
 Fauvel 1922, Augener 1927A, 1932, Pope 1943, Kott 1951, Day 1975,
 Poore et al., 1975 — WA 28/113/i; 29/113/i; 32/115/i, t; VIC 38/145/t;
 NSW 33/151/i, t; Campbell Is. 52/169/i
- AHM *Platynereis dumerilii antipoda* Hartman 1954 — SA 35/138/i; 36/137/i;
 TAS 41/144/i; NSW 33/151/i
 Russell 1962, Hutchings 1974 — NSW 32/152/e; QLD 27/153/t
- as *Nereis (Platynereis) australis* (non Schmarda) — fide Hartman 1954
 Augener 1913, 1924B — WA 25/113/t; NZ 34/172/i; 34/173/i; 36/174/i;
 39/173/t; 39/177/i; 41/174/t; 43/172/t
- Platynereis isolita* Gravier 1902
 Stephenson et al., 1974 — QLD 27/153/t
- Platynereis polyscalma* Chamberlin 1919
 Monro 1931 — QLD 16/145/i
- Platynereis* sp. Knox 1965 — NZ 44/167/d
- Pseudonereis anomala* Gravier 1902
 Fauvel 1922, Pope 1943 — WA 28/113/i; NSW 33/151/i
- AM as *Nereis nicholli* Kott 1951 — fide Hartman 1954 — WA
 29/113/i; 32/115/i
- Pseudonereis masalacensis* (Grube 1878)
 Pope 1943 — NSW 33/151/t

- HZM *Pseudonereis rotnnestiana* Augener 1913 — WA 32/115/i
Websterinereis punctata (Wesenberg — Lund 1949)
 Stephenson et al., 1974 — QLD 27/153/t

SPHAERODORIDAE

- Sphaerodoropsis parva* (Ehlers 1913) — fide Fauchald 1974
 as *Sphaerodorum parvum* Augener 1927A — NSW 37/150/o
Sphaerodoropsis spissum (Benham 1921) — fide Fauchald 1974
 as *Sphaerodorum spissum* Augener 1927A — NSW 33/151/i
Sphaerodoridium sp. Poore et al., 1975 — VIC 38/144/t

NOTOPHYCIDAE

- CM *Notophycus minutus* Knox and Cameron 1970 — NZ 48/166/i

LACYDONIDAE

- Paralacydonia weberi* Horst 1922
 Augener 1927B — NZ 37/176/t
 HZM as *Paralacydonia mortenseni* Augener 1924B — NZ 38/176/d

NEPHTYIDAE

- CM *Aglaophamus bathamae* Knox 1960A (nomen nudum) — Chatham Is.
 44/176W/t
Nephtys (*Aglaophamus*) *dibranchis* Grube 1878
 Augener 1922A, 1927A, Stephenson et al., 1974 — QLD 27/153/t;
 NSW ?37/149/o
Nephtys (*Aglaophamus*) *gippslandicus* Rainer and Hutchings 1977
 AM as *Aglaophamus gippslandicus* Rainer and Hutchings 1977 — VIC
 39/148/o
Nephtys (*Aglaophamus*) *macroura* Schmarda 1861
 ZUW as *Nephtys macroura* Schmarda 1861 — NZ 36/174/i
 Augener 1924B — NZ 36/175/o; 37/176/t; 47/169/i
 as *Nephtys macrura* (sic) Ehlers 1904, 1907 — NZ 36/174/?; 45/170/?
 as *Aglaophamus macroura* Knox 1960A, 1965, Estcourt 1967 — VIC
 40/150/a; NZ 36/174/i; 47/172/e; Chatham Is. 42/175W/d; 43/175W/o;
 44/175W/o
Nephtys (*Aglaophamus*) *maoriana* Knox 1960A (nomen nudum)
 CM as *Aglaophamus maoriana* Knox 1960A — Chatham Is. 43/177/vd;
 43/178/vd; 43/176W/d; 44/176W/d,vd; 45/178W/d
 Knox 1965 — NZ 44/167/d
Nephtys (*Aglaophamus*) *profundus* Rainer and Hutchings 1977

- AM as *Aglaophamus profundus* Rainer and Hutchings 1977 — VIC 39/148/a
as *Nephtys macrura* (sic) (non Schmarda)
Benham 1915A, 1916B, Augener 1927B — VIC 39/148/a; NZ 37/177/o
as *Aglaophamus macroura* (non Schmarda) Fauchald 1963 — VIC 40/150/a
as *Aglaophamus ?verrilli* (non McIntosh) Paxton 1974 — TAS 39/148/a
- BM *Nephtys* (*Aglaophamus*) *verrilli* McIntosh 1885 — NZ 41/174/t
as *Nephtys dibranchis* (non Grube) — fide Knox 1960A
Ehlers 1904, 1907, Augener 1924B, 1927B, Monro 1936, Rullier 1965,
Stephenson et al., 1970 — QLD 27/153/t; NZ 35/173/o; 36/174/t;
36/175/o; 37/176/t; 43/172/i
as *Aglaophamus verrilli* Knox 1960A, 1965, Paxton 1974, Estcourt 1975,
Rainer and Hutchings 1977 — QLD 19/146/t; 27/153/t; NZ 41/173/t;
44/167/d; Chatham Is. 43/177/vd; 43/178/vd; 43/176W/o; 43/177W/d;
44/176W/d
Nephtys (*Aglaophamus*) *virginis* Kinberg 1866B
as *Aglaophamus virginis* Knox 1960A — Chatham Is. 42/175/d; 43/175/d;
42/176W/t; 43/176W/o; 44/175W/d
Nephtys (*Inermonephtys*) *palpata* Paxton 1974
- AM as *Inermonephtys palpata* Paxton 1974 — QLD 20/148/i
Nephtys (*Micronephtys*) *sphaerocirrata* (Wesenberg-Lund 1949)
as *Micronephtys sphaerocirrata* Rainer and Hutchings 1977 — QLD
19/147/t; 27/153/t
- AM *Nephtys australiensis* Fauchald 1965 — SA 35/138/i; NSW 33/151/t; 34/150/?i
Paxton 1974 (partim), Hutchings 1974, Hutchings and Recher 1974,
Rainer and Hutchings 1977 — SA 35/138/e; 34/137/e; TAS 43/174/e;
VIC 37/144/e; 38/145/e; 38/142/i,e; NSW 29/153/e; 32/152/e; 32/151/e;
33/151/i; 35/150/e; 36/149/e; QLD 25/153/i,e; 25/152/e; 27/153/t
as *Nephtys gravieri* (non Augener 1913)
Augener 1927A, Rullier 1965 — VIC 38/145/t; QLD 27/153/i
- HZM *Nephtys gravieri* Augener 1913 — WA 32/115/t
Rainer and Hutchings 1977 — WA 33/115/e; SA 32/137/e
- AM as *Nephtys mirocirrus* Fauchald 1965 — SA 35/138/i
fide Paxton 1974, Rainer and Hutchings 1977
as *Nephtys australiensis* (non Fauchald) Paxton 1974 (partim) — WA
33/115/e
- AM *Nephtys inornata* Rainer and Hutchings 1977 — VIC 38/144/t; NSW 33/151/i,t;
35/150/t
- AM *Nephtys longipes* Stimpson 1865 — NSW 34/151/i
Rainer and Hutchings 1977 — VIC 37/149/i; 39/146/i; 38/144/t; NSW
32/152/i; 32/151/e; 34/150/i; 35/150/i,e; QLD 27/153/t

- AM,BM as *Nephtys vikingensis* Paxton 1974 — NSW 32/152/i; 35/150/i; QLD 27/153/i
 as *Nephtys picta* (non Ehlers) — fide Paxton 1974
 Knox and Cameron 1971 — VIC 38/144/i
 as *Nephtys* sp. Hutchings 1974 — NSW 32/152/i
- AM *Nephtys mesobranchia* Rainer and Hutchings 1977 — QLD 23/151/e
 Nephtys paradoxa Malm 1874
 Fauchald 1963, Paxton 1974 — NSW 37/150/vd
- AM *Nephtys semiverrucosa* Rainer and Hutchings 1977 — NT 12/130/i

GLYCERIDAE

Subfamily **Glycerinae**

- Glyceria americana* Leidy 1855
 Augener 1922A, 1924B, 1927A, 1927B, Knox 1960B, 1965, Rullier 1965, Estcourt 1967, Knox and Cameron 1971, Stephenson *et al.*, 1974, Hutchings 1974, Hutchings and Recher 1974, Poore *et al.*, 1975 — SA 35/138/?i; VIC 38/144/e,i,t; NSW 33/151/i; QLD 27/153/i,t; NZ 36/174/i,t; 36/175/o; 41/172/i; 41/174/i,o; 43/172/e,i,t; 44/167/d; 45/170/i,d; 47/169/i
- Glyceria capitata* Oersted 1843
 Poore *et al.*, 1975 — VIC 38/144/t
- ?MNHN *Glyceria gigantea* Quatrefages 1865
 Monro 1931 — QLD 16/145/?
- BM *Glyceria lamelliformis* McIntosh 1885 — NZ 41/174/t
 Knox 1960A, 1960B, 1965 — NZ 37/176/t; 39/176/t; 39/177/t; 44/167/d,vd; 45/170/t; Chatham Is. 42/176W/t; 43/176W/t,o; 44/176W/d
- CM *Glyceria lamellipoda* Knox 1960B — NZ 41/174/t; 43/172/i
 Glyceria lancadivae Schmarda 1861
 Rullier 1965 — QLD 27/153/t
- Glyceria opisthobranchiata* Marenzeller 1879
 Pope 1943 — NSW 33/151/t
- ?ZUW *Glyceria ovigera* Schmarda 1861 — NZ 36/174/?i
 Ehlers 1904, 1907, Benham 1909 — NZ 36/174/?; 45/170/o; 46/170/o; 47/169/?
- Glyceria prashadi* Fauvel 1932
 Stephenson *et al.*, 1974 — QLD 27/153/t
- Glyceria tessellata* Grube 1863
 Benham 1916B, Augener 1924B, 1927A, Knox 1951B, 1960A, 1960B — TAS 42/148/d; VIC 39/148/?i; 38/149/o; NSW 37/150/o; NZ 34/172/o,d; 35/174/t; 39/176/t; 40/173/d; 41/174/t; 44/167/d; 45/166/o; Chatham Is. 43/176/vd; 42/176W/t; 43/176W/t,o; 44/176W/d

- Glycera tridactyla* Schmarda 1861
 Augener 1927A — NSW 37/149/i
- NMV *Hemipodus australiensis* Knox and Cameron 1971 — VIC 38/144/i
- CM *Hemipodus digitifera* Knox 1960A — Chatham Is. 44/176W/t
 Knox 1960B — NZ 41/174/t
- CM *Hemipodus ellesmerensis* Knox 1960B — NZ 43/172/i
- Hemipodus simplex* (Grube 1857)
 Ehlers 1904, 1905, 1907, Augener 1924A, 1924B, 1927A, 1927B,
 Benham 1950; Knox 1960B — NSW 37/150/o; NZ 36/174/i; 37/176/t;
 40/173/i; 41/174/?; 43/169/i; 43/172/e,i,t; 47/169/t; Auckland Is.
 50/166/i,o

Subfamily Goniadinae

- Glycinde dorsalis* Ehlers 1904
- HZM as *Goniada (Glycinde) dorsalis* Ehlers 1904 — Chatham Is. (?i)
 Ehlers 1907, Augener 1924B, 1927B — NZ 36/175/d; 36/176/?; 37/176/i;
 43/172/?; 47/168/t
- Glycinde trifida* (McIntosh 1885)
- BM as *Eone trifida* McIntosh 1885 — NZ 41/174/t
- HZM *Goniada antipoda* Augener 1927A — VIC 38/149/d
- ?MNHN *Goniada australiensis* Quatrefages 1865 — "Australia"
- Goniada brunnea* Treadwell 1906
 Knox 1960A — Chatham Is. 42/175/d; 43/176W/o,d; 44/176W/d
- Goniada emerita* Audouin and Milne Edwards 1833
 Knox 1960A, Estcourt 1968, Knox and Cameron 1971 — VIC 38/144/t;
 NZ 40/174/d; Chatham Is. 43/176W/t
- as *Goniada australiensis* (non Quatrefages) Augener 1927A — NSW
 33/151/t
- OM *Goniada grahami* Benham 1932 — NZ 45/170/o
- OM *Goniada maorica* Benham 1932 — NZ 45/170/o
 Knox 1965 — NZ 44/167/d
- as *Goniada eximia* (non Ehlers) — fide Benham 1932
 Benham 1909 — NZ 39/177/d or 45/171/d
- BM *Goniada tripartita* Monro 1931 — QLD 16/145/t

EUNICIDAE

Subfamily Eunicinae

- Eunice afra* Peters 1854
 Monro 1931, Day 1975 — QLD 16/145/i; WA 32/115/t
- Eunice afra paupera* Grube 1878
 Day 1975 — WA 32/115/t

Eunice antennata (Savigny 1820)

Ehlers 1907, Benham 1909, Augener 1913, 1922A, 1922B, 1927A, Fauvel 1917, 1922, Monro 1924A, 1931, Pope 1943, Kott 1951, Rullier 1965, Knox and Cameron 1971, Poore *et al.*, 1975 — WA 15/115/i; 19/120/t,o; 21/115/?i; 25/113/t; 32/115/i,t; 33/115/t; 35/117/t; SA 34/147/?; 34/138/?; VIC 38/144/i,t; NSW 33/151/i,t; QLD 9/143/t; 10/142/t; 16/145/t; 14/145/t,o; 19/148/t; 20/149/i; 27/153/i,t; NZ 45/170/o; 46/168/?

?MNHN as *Eunice gaimardi* Quatrefages 1865 — New Zealand

BM as *Eunice bassensis* McIntosh 1885 — VIC 19/146/o
Benham 1915A — SA 36/137/o; VIC 39/148/?; TAS 40/145/?; 42/148/?; 44/145/?

BM as *Eunice torresensis* McIntosh 1885 — QLD 10/142/t

Eunice aphroditois (Pallas 1788)

McIntosh 1885, Ehlers 1907, Benham 1909, 1927, Augener 1913, 1927A, Fauvel 1917, Monro 1931, Knox and Green 1972C — WA 19/118/i; 33/115/t; SA 34/137/?; 34/138/?; VIC 38/148/d; 38/149/d; 38/145/t; NSW 33/151/i; 34/151/o; 36/150/o,d; 37/150/d; NZ 34/172/o; 36/174/?; 37/176/o; 40/172/?; 42/173/?; 43/172/?; 45/170/i,o

as *Eunice tentaculata* (non Quatrefages) Augener 1913 — WA 33/151/t

?MNHN *Eunice australis* Quatrefages 1865 — New Zealand

Ehlers 1904, 1905, 1907, Benham 1909, 1927, Fauvel 1917, 1922, Augener 1922A, 1924A, 1924B, 1927A, 1927B, Monro 1936, Knox 1951B, 1960A, 1965, Knox and Cameron 1971, Knox and Green 1972C — WA 28/113/i; 32/115/?; SA 34/137/?; 34/138/?; VIC 38/149/d; 38/144/t; 38/145/t; NZ 34/172/o,d; 34/173/d; 36/174/t; 36/175/o; 37/175/i; 37/176/o; 39/173/t; 40/172/?; 41/174/t; 41/175/?; 42/173/i; 43/172/t,d; 44/167/d; 45/166/t; 45/170/?; 46/166/?; 46/170/?; 47/168/o; Chatham Is. 42/176W/i; 44/175W/d; Auckland Is. 50/166/o

?OM as *Eunice leuconuchalis* Benham 1900 — NZ 40/172/?

Eunice filamentosa Grube 1856

as *Eunice denticulata* (non Webster) Kott 1951 — WA 15/115/i

Eunice grubei Gravier 1900

Monro 1931, Rullier 1965 — QLD 16/145/?; 27/153/o,?i

Eunice indica Kinberg 1866

Monro 1939,? Stephenson *et al.*, 1974 — TAS 43/146/o; ?QLD 27/153/t

Eunice longicirris Grube 1870

Augener 1922B — WA 19/120/t

Eunice makemoana (Chamberlin 1919)

Monro 1939 — TAS 41/148/d

Eunice microprion Marenzeller 1879

Monro 1924A — QLD 20/149/i

Eunice (*Nicidion*) *balfouriana* McIntosh 1885

- BM as *Nicidion balfouriana* McIntosh 1885 — Kermadec Is. 29/178W/vd
- CM *Eunice (Nicidion) curticirrus* Knox 1960A — Chatham Is. 43/176W/o
Eunice (Nicidion) gracilis Crossland 1904
as *Nicidion gracilis* Augener 1913 — WA 25/113/t; 32/115/i
- ?MNHN *Eunice quoya* Quatrefages 1865 — Australia (indeterminate)
- CM *Eunice rubella* Knox 1951B — NZ 40/173/d
Knox 1960A, Knox and Green 1972C — NZ 41/175/?; 42/173/?;
43/172/?; 45/166/?; 45/170/?; Chatham Is. 42/175/d; 43/176W/o
Eunice (Palolo) siciliensis Grube 1840
Augener 1913, 1922B, 1927A, Benham 1915A, Fauvel 1917, 1922,
Monro 1924A, Pope 1943, Kott 1951, Knox 1960A, Knox and Cameron
1971, Knox and Green 1972C — WA 19/120/t; 25/113/t; 32/115/e,i,t; SA
34/138/?; VIC 37/150/d; 38/144/i,t; 38/145/t; 39/149/o; NSW 33/151/i;
34/150/i; QLD 10/142/?; Kermadec Is. 30/178W/?; Chatham Is.
43/176W/t
as *Palolo siciliensis* Poore et al., 1975 — VIC 38/144/t
Eunice (Palolo) edentulum (Ehlers 1901)
as *Eunice siciliensis* var. *edentula* Monro 1939 — TAS 42/148/d
- ?MNHN *Eunice tentaculata* Quatrefages 1865 — VIC 38/145/?i
Fauvel 1917, 1922, Benham 1921, 1927, Augener 1924B, Monro 1939,
Knox 1951B, 1960A, Knox and Cameron 1971, Knox and Green 1972C,
Day 1975 — WA 28/113/i; 32/115/t; SA 32/133/i; 34/138/?; TAS 42/148/d;
41/148/d; VIC 38/144/i,t; 38/145/t; NZ 34/172/d; 34/173/d; 40/173/d;
41/174/t; 42/173/?; 45/170/?; 46/168/?; 45/166/?; Chatham Is.
43/176W/t,o; 44/175W/d; 44/176W/t
- BM as *Eunice pycnobranchiata* McIntosh 1885 — VIC 39/146/o
Benham 1915A, 1916A — TAS 40/145/?; 42/147/d; 43/147/d; VIC
39/147/?; 39/148/d; NSW 32/151/?; NZ 40/172/?; 41/172/?; 44/171/t;
46/168/t; 47/168/?
- BM *Eunice tribranchiata* McIntosh 1885 — QLD 10/142/t
- HZM *Eunice tridentata* Ehlers 1905 — NZ 39/177/?
Augener 1924A, Knox and Green 1972C — NZ 39/177/?
Eunice tubifex Crossland 1904
Augener 1913, 1922B, 1927A, Fauvel 1917 — WA 19/120/t; 25/113/t;
29/113/i; SA 34/137/?; VIC 39/148/o; NSW 37/150/o
Eunice vittata (Delle Chiaje 1828)
McIntosh 1885, Augener 1927A, Knox 1960A — VIC 39/146/o; NSW
33/151/t; 37/150/o; Chatham Is. 44/176W/t; 44/175W/d; 45/178W/d
Lysidice ninetta Audouin and Milne Edwards 1834
Fauvel 1917, Rullier 1965, Knox and Cameron 1971, Knox and Green
1972C — SA 34/138/?; VIC 38/144/t; 38/145/t; QLD 27/153/t; NZ
42/173/?; Kermadec Is. 30/138/?

- SSM as *Lysidice brevicornis* Kinberg 1865 — NSW 33/151/i
Augener 1913, 1922C, 1924B, 1927A — WA 25/113/t; NSW 37/150/o;
NZ 34/172/o; 47/168/t
- Lysidice ninetta collaris* Grube 1869
- as *Lysidice collaris* Augener 1913, Monro 1924A, 1931, Fauvel 1919, 1922,
Pope 1943, Kott 1951, Day 1975 — WA 25/113/t; 28/113/i; 29/113/i;
32/115/i; SA 35/136/i; NSW 33/151/i,t; QLD 9/143/t; 14/145/t; 16/145/i
- Lysidice robusta* Stimpson 1856 — NSW 33/151/i
Kinberg 1866, Augener 1922A, 1922B, 1922C, 1927A — WA 19/120/t,o;
NSW 33/151/i; 34/150/i; QLD 10/142/?
- as *Lysidice collaris* (non Grube) Fauvel 1917 — SA 34/138/?
- Marphysa aenea* (Blanchard 1849)
Ehlers 1907, Augener 1924A, 1924B, Benham 1950, Rullier 1965 —
QLD 27/153/i; NZ 43/169/i; 47/168/i; Auckland Is. 50/166/i
- as *Marphysa capensis* (Schmarda 1861) — fide Knox 1960A
Knox 1960A, Knox and Cameron 1970, Knox and Green 1972C — NZ
41/174/i; 42/173/i; 43/169/i; 46/168/e,i; 47/169/i; 48/166/i; Chatham Is.
42/176W/i; 43/176W/i
- as *Marphysa corallina* (non Kinberg) — fide Knox 1960A
Ehlers 1904 — Chatham Is. (i)
- AM *Marphysa bifurcata* Kott 1951 — WA 32/115/i
- Marphysa depressa* (Schmarda 1861)
Ehlers 1904, 1907, Augener 1924B, Knox and Green 1972C — NZ
34/173/i; 36/174/?; 36/175/?; 42/173/?; 46/168/?;
- ?ZUW as *Eunice depressa* Schmarda 1861 — NZ 36/174/i
- Marphysa disjuncta* Hartman 1961
Knox and Green 1972C — NZ 39/177/?; 44/167/d
- Marphysa macintoshi* Crossland 1903
as *Marphysa furcellata* Crossland 1903 — fide Day 1957
Augener 1913 — WA 32/115/i
- Marphysa mossambica* (Peters 1854)
Fauvel 1917, Monro 1931 — QLD 16/145/i; SA 34/138/i
- SSM as *Nauphanta novae Hollandiae* Kinberg 1865 — NSW 33/151/i
as *Marphysa novaehollandiae* Augener 1922A — QLD 10/142/?
- Marphysa sanguinea* (Montagu 1815)
Monro 1938, Kott 1951, Rullier 1965, Hutchings 1974, Hutchings and
Recher 1974 — WA 32/115/e; NSW 32/152/e; 33/151/i; QLD 27/153/i,t
- CM *Marphysa unibranchiata* Knox and Cameron 1970 — NZ 48/166/i
Knox and Green 1972C — NZ 42/173/?; 43/169/?; 43/172/?
- BM *Paramarphysa parvipes* Benham 1927 — NZ 34/173/d
Knox and Green 1972C — NZ (record repeated)

Subfamily **Onuphidinae**

- NMV *Diopatra aciculata* Knox and Cameron 1971 — VIC 38/144/e
- CM *Diopatra akarana* Knox and Hicks 1973 — NZ 36/174/i
Diopatra amboinensis Audouin and Milne Edwards 1883
Collin 1902 — QLD 10/142/?
- SSM *Diopatra dentata* Kinberg 1865 — NSW 33/151/t
Augener 1913, 1922B, 1922C, Pope 1943 — WA 19/120/t,o; ?25/113/t;
NSW 33/151/t
Diopatra sp. Monro 1924A — QLD 9/143/t
Epidiopatra hupferiana Augener 1918
Augener 1927A — NSW 37/150/t,o; VIC 38/149/o
Hyalinoecia brevicornis Grube 1878
as *Hyalinoecia brevicirris* (sic) Grube 1878A — QLD 27/153/o
Hyalinoecia tubicola (Müller 1766)
Benham 1915A, 1927, Augener 1924B, Monro 1936, Knox 1960A, 1965,
Knox and Hicks 1973 — VIC 39/148/o,d; NZ 34/172/o,d; 34/173/d;
35/172/o; 36/175/o,d; 37/177/d; 39/177/d; 41/176/d; 44/167/d; 46/168/d;
Chatham Is. 43/178/vd; 43/179/d,vd; 42/175W/t; 44/176W/o,vd;
44/177W/d
- BM as *Hyalinoecia tubicola* var. *longibranchiata* McIntosh 1885 — NZ 41/174/t
- BM as *Hyalinoecia tubicola* var. *papuensis* McIntosh 1885 — QLD 10/142/o
as *Onuphis tubicola* Ehlers 1907 — NZ 41/174/?
- KM *Onuphis aucklandensis* Augener 1924B — NZ 36/174/t
Augener 1927A, Monro 1936 — NSW 33/151/t; 37/150/o; NZ 35/173/t,o
as *Onuphis tenuisetis* (non McIntosh) Benham 1909 — NZ 39/177/?i
- CM as *Nothria aucklandensis* Knox and Hicks 1973 — NZ 36/174/?; 39/177/o;
45/170/i
- CM *Onuphis pectinata* Knox and Hicks 1973 — NZ 43/172/i; 44/171/i
Onuphis proalopus Chamberlin 1919
Knox 1960A — Chatham Is. 43/175/d; 43/177/vd; 43/178/vd;
44/176W/t,vd
Onuphis teres (Ehlers 1868)
Hedley 1915, Fauvel 1917, Augener 1927A, Pope 1943 — NSW
33/151/i; 34/151/i; QLD (?locality)
as *Diopatra teres* Ehlers 1868 — NSW 33/151/i
- Onuphis* (*Nothria*) *africana* Augener 1918
as *Onuphis africana* Augener 1924B, 1927B — NZ 34/173/d; 36/175/o;
?37/176/t
- Onuphis* (*Nothria*) *conchylega* Sars 1835
Knox 1960A — Chatham Is. 42/175/d; 43/177/vd; 43/177W/d

- as *Nothria conchylega* Knox and Hicks 1973 — NZ 34/174/?; 36/175/?
Onuphis (Nothria) holobranchiata Marenzeller 1879
 Knox and Cameron 1971 — VIC 38/144/t
 as *Nothria holobranchiata* Poore et al., 1975 — VIC 38/144/t
 as *Onuphis holobranchiata* Augener 1913, 1914 — WA 25/113/t; 32/115/i
Onuphis (Nothria) iridescens (Johnson 1901)
 Knox 1960A — Chatham Is. 43/175/d; 43/178/vd; 44/177W/d
 BM *Onuphis (Nothria) minuta* McIntosh 1885 — NZ 37/179/a
 as *Nothria minuta* Knox and Hicks 1973 — NZ (record repeated)
Onuphis spp. Monro 1931 — QLD 16/145/t
 Knox 1951B — NZ 44/167/d
 Stephenson et al., 1974 — QLD 27/153/t
Rhamphobranchium chuni Ehlers 1908
 Augener 1924B, 1927A, Knox 1960A, Knox and Hicks 1973 — NSW
 37/150/o; NZ 36/175/o; 39/177/d; Chatham Is. 42/175/d; 43/177/vd;
 43/176W/t,d
 NZOI *Rhamphobranchium maculatum* Estcourt 1966B — NZ 34/172/t
 Knox and Hicks 1973 — NZ 37/175/t; 42/173/t
Rhamphobranchium sp. Stephenson et al., 1974 — QLD 27/153/t

Subfamily Lysaretinae

- OM *Halla* sp. Benham 1900 — NZ 40/173/?i; 40/172/?i
 AM *Lysarete australiensis* Benham 1915A — VIC 37/148/d
Oenone fulgida (Savigny 1818)
 Augener 1913, 1922A, 1922C, Knox and Cameron 1971, Knox and
 Green 1972B — WA 19/120/t; 25/113/t; VIC 38/144/t; QLD 10/142/?; NZ
 43/173/t
 as *Aglaurides fulgida* Ehlers 1907, Fauvel 1917 — SA (?locality); NZ
 41/172/?
 lost ?as *Halla australis* Haswell 1886 — NSW 33/151/t
 OM as *Oenone haswelli* Benham 1915A — NSW 33/152/o; VIC 40/148/i
 CM *Tainokia iridescens* Knox and Green 1972B — NZ 42/173/i

Subfamily Lumbrinerinae

- CM *Lumbrineris aoteoroae* Knox and Green 1972A — NZ 36/174/i; 39/177/t,o;
 41/174/t; 44/167/t; 45/166/t
Lumbrineris brevicirra (Schmarda 1861)
 Knox 1960A, Knox and Green 1972A — NZ 36/174/i; 39/177/d; 41/172/i;
 42/173/i; 43/172/i; 43/173/?; 44/171/i; Chatham Is. 43/178/vd
 ?ZUW as *Notocirrus brevicirrus* Schamarda 1861 — NSW 33/151/i

- as *Lumbriconeris brevicirra* Ehlers 1904, 1905, 1907, Augener 1913, 1924B, 1927A, Benham 1927 — WA 25/113/t; 32/115/t; 35/117/t; NSW 33/151/i; 34/150/i; 37/150/o; NZ 34/172/o,d; 36/174/i; 37/175/i; 43/172/?; Chatham Is. (t)
- BM as *Lumbriconereis neozealandiae* McIntosh 1885 — NZ 37/179/a
- Lumbrineris coccinea* (Renieri 1804)
Day 1975 — WA 32/115/t
- ?ZUW as *Notocirrus sphaerocephalus* Schmarda 1861 — fide Day 1975 — NZ 36/174/i
- SSM as *Lumbriconereis mirabilis* Kinberg 1866A — NSW 33/151/t
- as *Lumbriconereis sphaerocephala* Ehlers 1904, 1905, 1907, Benham 1909, 1915A, Augener 1913; 1924B, 1927A, 1927B — WA 25/113/t; 33/115/t; NSW 33/151/i; 37/149/i; VIC 38/144/d; 38/145/t; 38/149/o; 39/148/d; NZ 34/172/o,d; 34/173/i; 36/174/i; 36/175/o; 37/176/t; 41/174/o; 43/172/t; 45/175/o; 46/170/o; 47/169/i; Chatham Is. (i)
- as *Lumbrineris sphaerocephala* Knox 1960A, Estcourt 1967, Knox and Green 1972A — NZ 36/175/i; 39/177/t,o; 41/174/o; 41/175/vd; 43/169/i; 43/172/e,i; 44/167/?; 47/169/t; Chatham Is. 42/175/d; 43/176/d; 43/177/vd; 43/178/vd; 43/176W/i,t,o; 43/177W/d; 44/176W/t; 44/177W/d
- Lumbrineris guliemi* Benham 1915
- OM as *Lumbriconereis guliemi* Benham 1915A — TAS 42/148/o; VIC 39/148/d
Augener 1927A — NSW 37/150/o; VIC 38/149/d
- CM *Lumbrineris galathea* Knox and Green 1972A — NZ 41/174/?; 41/175/d; 44/167/t,d
- Lumbrineris jacksoni* Kinberg 1866A
- SSM as *Lumbriconereis jacksoni* Kinberg 1866 — NSW 33/151/i
Kott 1951 — WA 32/115/i
- = *Lumbrineris brevicirra* (Schmarda) — fide Augener 1913, 1927A
- Lumbrineris latreilli* Audouin and Milne Edwards 1834
Knox and Cameron 1971, Hutchings 1974, Hutchings and Recher 1974, Poore et al., 1975, Stephenson et al., 1976 — VIC 38/144/i,t; NSW 32/152/e; 33/151/i; QLD 27/153/t
- CM *Lumbrineris lynnei* Knox 1951B — NZ 40/173/d
- ?SSM *Lumbrineris magalhaensis* Kinberg 1866
Augener 1924A, Knox and Green 1972A — NZ 41/174/?; 44/167/t,o,d; 45/166/t,o; 37/176/t; 42/166/o; 44/167/d; Auckland Is. 50/166/i,t,o; Campbell Is. 52/169/o
- Lumbrinereis mucronata* (Ehlers 1908)
Knox and Green 1973 — QLD 27/153/t
- Lumbrineris sulcaticeps* (Benham 1927) — fide Knox and Green 1972A

- BM as *Aotearia sulcaticeps* Benham 1927 — NZ 34/172/d
Lumbrineris tetraura (Schmarda 1861)
 Day 1975 — WA 32/115/t
Lumbrineris sp. Knox 1960A — Chatham Is. 43/176W/t; 44/176W/t
 Knox 1965 — NZ 44/167/t,d
- BM *Ninoe falklandica* Monro 1936
 Knox 1960A, Knox and Green 1972A — NZ 44/167/o,d; Chatham Is.
 43/176/d; 43/178/vd; 44/176W/t
 as *Ninoe leptognatha* (non Ehlers) — fide Knox 1960A
 Augener 1924B — NZ 37/177/d; 39/177/o; 43/172/t
Ninoe sp. Knox 1965 — NZ 44/167/d

Subfamily **Arabellinae**

- Arabella iricolor* (Montagu 1804)
 Knox and Cameron 1971, Stephenson *et al.*, 1974 — QLD 27/153/t;
 VIC 38/144/t
 as *Aracoda iricolor* Ehlers 1907, Augener 1924B, 1927A — NSW 33/151/i;
 37/150/o; NZ 34/172/i; 41/174/o; 43/169/?
 as *Aracoda multidentata* Ehlers 1887
 Augener 1913 — WA 20/118/i; 32/115/i,t
- Arabella iricolor iricolor* (Montagu 1804)
 Poore *et al.*, 1975 — VIC 38/144/t
- Arabella debilis* Ehlers var. *maorica* (Augener 1924)
 KM,HZM as *Aracoda debilis* var. *maorica* Augener 1924B, 1927B — NZ 36/175/o;
 37/176/i
- BM *Arabella longipedata* Monro 1931 — QLD Merinda (?); 16/146/o
Arabella mutans (Chamberlin 1919)
 Day 1975 — WA 32/115/t
Arabella sp. Hutchings 1974 — NSW 32/152/e
- HZM *Drilonereis australiensis* Augener 1922A — QLD 10/142/?
 Rullier 1965 — QLD 27/153/i
Drilonereis spp. Stephenson *et al.*, 1974 — QLD 27/153/t

Subfamily **Dorvilleinae**

- Dorvillea australiensis* (McIntosh 1885)
 Knox 1960A, Knox and Cameron 1971, Poore *et al.*, 1975 — VIC
 38/144/i,t; Chatham Is. 43/176W/t
- BM as *Staurocephalus australiensis* McIntosh 1885 — VIC 39/146/o
 as *Stauronereis australiensis* Augener 1913, 1924B, 1927A, 1927B, Benham
 1915A, Fauvel 1917 — WA 25/113/t; 32/115/i; 33/115/t; SA ?locality (i);
 TAS 42/147/?i; VIC 38/144/?i; NSW 33/151/i,t; NZ 34/173/d; 36/174/t;
 37/176/t; 41/174/t; 47/169/t

as *Stauronereis australis* (non Haswell) Ehlers 1904, 1905, 1907 — NZ 40/173/?; 45/170/?; 47/169/?

Ophryotrocha claparedii Studer 1878
Augener 1924A, Benham 1950 — Auckland Is. 50/166/i

Schistomeringos australis (Haswell 1886) — fide Jumars 1974

lost as *Staurocephalus australis* Haswell 1886 — NSW 33/151/i

as *Stauronereis australis* Ehlers 1904, Augener 1913 — WA 25/113/t; 32/115/e,t; 35/117/t; NZ 40/173/?

Schistomeringos incerta (Schmarda 1861) — fide Jumars 1974

?ZUW as *Cirrosyllis incerta* Schmarda 1861 — New Zealand

as *Stauronereis incerta* Ehlers 1904, 1907 — NZ 43/169/?

as *Dorvillea incerta* Knox 1960A — Chatham Is. 43/176W/d; 44/176W/d

Schistomeringos loveni (Kinberg 1866A) — fide Jumars 1974

SSM as *Staurocephalus loveni* Kinberg 1866 — NSW 33/151/t

as *Stauroneris loveni* Augener 1922C, 1924B, 1927A — VIC 38/149/d; NZ 34/172/d; 36/174/i; 45/170/?

as *Dorvillea loveni* Knox 1965 — NZ 44/167/t,d

HISTRIOBDELLIDAE

?AM *Stratiodrilus novaehollandiae* Haswell 1913 — NSW on the fresh-water crayfish *Astacopsis serratus*

?AM *Stratiodrilus tasmanicus* Haswell 1900 — TAS on the fresh-water crayfish *Astacopsis franklinii*

POLYCHAETA : SEDENTARIA

SPIONIDAE

NZOI *Aonides triffidus* Estcourt 1967 — NZ 43/172/e

Aonides oxycephala (Sars 1862)
Poore et al., 1975 — VIC 38/144/t

NMW *Boccardia* (*Boccardia*) *androgyna* Read 1975 — NZ 41/174/t

Boccardia (*Boccardia*) *chilensis* Blake and Woodwick 1971
Read 1975 — NZ 36/174/i; 41/174/i

OM as *Boccardia jubata* Rainer 1973 — NZ 45/170/t — fide Read

AM *Boccardia limnicola* Blake and Woodwick 1976 — VIC 37/141/fw; 37/149/fw

NMW *Boccardia* (*Boccardia*) *magniovata* Read 1975 — NZ 41/174/i

OM *Boccardia otakouica* Rainer 1973 — NZ 45/170/t
Read 1975 — NZ 41/174/i

- Boccardia polybranchia* (Haswell 1885)
- lost as *Polydora (Leucodora) polybranchia* Haswell 1885 — NSW 32/151/i
as *Polydora polybranchia* Ehlers 1904, 1905, 1907, Augener 1924A, 1926, Wood 1968 — NZ 34/172/i; 36/174/i; 40/173/?; 43/172/?; Auckland Is. 50/166/o; Campbell Is. 52/169/t
- NMW *Boccardia (Boccardia) wellingtonensis* Read 1975 — NZ 41/174/i
Boccardia (Paraboccardia) acus Rainer 1973 — fide Read 1975
Read 1975 — NZ 35/174/i; 36/174/i; 41/174/i, t
- OM as *Paraboccardia acus* Rainer 1973 — NZ 45/170/i
Boccardia (Paraboccardia) knoxi Rainer 1973 — fide Read 1975
Read 1975 — NZ 41/174/i
- OM as *Paraboccardia knoxi* Rainer 1973 — NZ 45/170/i
- OM *Boccardia (Paraboccardia) lamellata* Rainer 1973
as *Paraboccardia lamellata* Rainer 1973 — NZ 45/170/t
- Boccardia (Paraboccardia) syrtis* Rainer 1973
Read 1975 — NZ 36/174/i; 41/174/i
- OM as *Paraboccardia syrtis* Rainer 1973 — NZ 45/170/i
as *Boccardia polybranchia* (non Haswell) — fide Rainer
Estcourt 1967 — NZ 43/172/e
- Dispio* sp. Hutchings and Recher 1974 — NSW 33/151/i
- Malacoceros indicus* (Fauvel 1928)
as *Scolecopsis indica* Monro 1931 — QLD 16/145/i
- Malacoceros* sp. Hutchings and Recher 1974 — NSW 33/151/i
- Paraprionospio pinnata* (Ehlers 1901) — fide Foster 1971
as *Prionospio pinnata* Augener 1927A, 1927B, Estcourt 1967 —
NZ 37/176/i, o; 43/172/e
- Polydora armata* Langerhans 1880
Augener 1914, Rainer 1973, Read 1975 — WA 25/113/t; 29/114/t; NZ
41/174/i; 45/170/i, t
- as *Polydora monilaris* Ehlers 1904 — NZ 40/173/?
Ehlers 1905 — NZ 40/173/?; 43/173/?
- Polydora ciliata* (Johnston 1838)
Haswell 1885, Whitelegge 1890, Day 1975 — ?WA 32/115/t; NSW
32/151/i; 33/151/i
- OM *Polydora dorsomaculata* Rainer 1973 — NZ 45/170/t
- Polydora giardi* (Mesnil 1896)
Rainer 1973, Read 1975 — NZ 41/174/i; 45/170/t
- Polydora hoplura* Claparède 1870
Read 1975 — NZ 41/174/i

- OM *Polydora quadricirrata* Rainer 1973 — NZ 45/170/t
Polydora sp. Knox 1965 — NZ 44/167/d
 Stephenson et al., 1974 — QLD 27/153/t
- HZM *Polydorella prolifera* Augener 1914 — WA 25/113/t
- KM *Prionospio aucklandica* Augener 1924A — Auckland Is. 50/166/t
 Augener 1926 — NZ 34/172/d; 36/175/o
Prionospio fallax Söderström 1920 — fide Foster 1971
 as *Prionospio malmgreni* ?Claparède 1869, Augener 1914, Knox 1965,
 Hutchings 1974 — WA 33/115/t; 35/117/t; NSW 32/152/e; NZ 44/167/d
- AM *Prionospio* sp. Hutchings and Recher 1974 — NSW 33/151/i
Pseudopolydora kempfi (Southern 1921)
 Poore et al., 1975 — VIC 38/144/t
Pseudopolydora paucibranchiata Okuda 1937
 Read 1975 — ?NZ 41/174/i
Pygospio sp? Knox 1965 — NZ 44/167/d
- BM *Scolecopides benhami* Ehlers 1907 — NZ 43/169/?
 Estcourt 1967 — NZ 43/172/e
Scolecopides sp. Estcourt 1967 — NZ 43/172/e
- KM *Scolelepis antipoda* (Augener 1926)
 as *Pseudonerine antipoda* Augener 1926 — NZ 47/168/i
Scolelepis sp. Wood 1968 — NZ 36/174/i
 Hutchings 1974 — NSW 32/152/e
- BM *Spio aequalis* Ehlers 1904 — Chatham Is. (?)
- HZM *Spio mesnili* Augener 1914 — WA 25/113/t
Spiophanes kroeyeri Grube 1860
 as *Spiophanes kröyeri* Augener 1927A — VIC 38/149/d
Spiophanes sp. Augener 1914 — WA 25/113/t
 Stephenson et al., 1974 — QLD 27/153/t

MAGELONIDAE

- Magelona cincta* Ehlers 1908
 Stephenson et al., 1974 — QLD 27/153/t
- AM *Magelona dakini* Jones 1978 — NSW 33/151/e
- lost *Malegona papillicornis* Müller 1858 — species inquirenda — fide M. L. Jones
 1977
 Ehlers 1907, Wood 1968 — NZ 36/174/i
Magelona sp. Stephenson et al., 1974 — QLD 27/153/t
 Hutchings and Recher 1974 — NSW 33/151/i

ACROCIRRIDAE

- AM *Acrocirrus aciculigerus* Kudenov 1976 — NSW 33/151/i
Acrocirrus trisectus Banse 1969
 as *Acrocirrus validus* (non Marenzeller) — fide Banse 1969
 Ehlers 1907 — NZ 36/174/i; 45/170/i
- NMV, AM *Macrochaeta australiensis* Kudenov 1976 — VIC 37/144/i, t

CHAETOPTERIDAE

- Chaetopterus variopedatus* (Renier 1804)
 Pope 1946, Rullier 1965, Knox and Cameron 1971, Poore *et al.*, 1975 —
 VIC 38/144/t; 38/145/t; QLD 27/153/i, t
 as *Chaetopterus luteus* Stimpson 1856 — NSW 33/151/i
- ?ZUW as *Chaetopterus macropus* Schmarda 1861 — NSW 34/150/i
 as *Chaetopterus variopedatus* var. *macropus* Augener 1914 — WA
 32/115/e
- Mesochaetopterus sagittarius* (Claparède 1870) — fide Bhaud 1969
 as *Mesochaetopterus minutus* Potts 1914
 Monro 1931, Stephenson *et al.*, 1974 — QLD 10/142/?; 16/145/i;
 27/153/t
- Phyllochaetopterus socialis* Claparède 1870
 Poore *et al.*, 1975 — VIC 38/144/t
 as *Phyllochaetopterus pictus* Crossland 1903
 Augener 1914, 1924A, 1926, 1927A — WA 17/121/?; 32/115/i?; VIC
 38/145/t; NSW 37/150/d; NZ 36/174/i; 41/174/t; Auckland Is. 50/166/i

CIRRATULIDAE

- Cirratulus cirratus* (Müller 1776)
 as *Cirratulus jucundus* (Kinberg 1865)
 Augener 1927A — VIC 38/149/d
- Cirratulus (Cirrineris) nuchalis* Ehlers 1907 — NZ 36/174/?
- Cirratulus patagonicus* (Kinberg 1866)
 Knox and Cameron 1970 — NZ 48/166/i
- Cirratulus* sp. Knox 1965 — NZ 44/167/d
- Cirriformia chrysoderma* (Claparède 1868)
 as *Cirratulus chrysoderma* Day 1975 — WA 32/115/t
- Cirriformia filigera* (della Chiaje 1828)
 Knox and Cameron 1971, Day 1975 — WA 32/115/i, t; VIC 37/144/i, t;
 38/141/i; 38/144/i, t; 38/145/i, t; 39/146/i, t
 as *Cirratulus australis* Quatrefages 1865 — NSW 35/150/i
 as *Cirratulus (Timarete) anchylochaeta* (non Schmarda) Augener 1914
 (p.p.) — WA 17/121/?

Cirriformia tentaculata (Montagu 1808)

Knox and Cameron 1971, Hutchings 1974 — VIC 38/144/i, t;
38/145/i, t; NSW 32/152/e

as *Cirratulus anchylochaetus* Schmarda 1861 — New Zealand

as *Cirratulus anklochaeta* (sic) Stephenson et al., 1974 — QLD 27/153/t

as *Cirratulus (Timarete) anchylochaeta* Augener 1914 (partim)

Augener 1926, 1927A, 1927B — WA 17/121/?; 25/113/t; 29/114/t; 32/115/i, t;
33/115/t; 35/117/i, t; NSW 33/151/i, t; 37/150/o; NZ 34/172/i; 34/173/i;
35/174/i; 36/174/i; 37/176/i; 43/172/i; 45/170/?

as *Audouinia anchylochaeta* Pope 1943, Knox 1951B, Rullier 1965 — NSW
33/151/i, t; QLD 27/153/i; NZ 40/173/d

Dodecaceria berkeleyi Knox 1971 — NZ 40/173/i; 42/173/i; 43/172/?

Dodecaceria joubini Gravier 1906

Augener 1914 — WA 25/113/t

COSSURIDAE

Cossura sp. Poore et al., 1975 — VIC 38/144/t — also present in 50-100 m off
New South Wales and New Zealand (personal observation)

HETEROSPIONIDAE

Heterospio sp.

as *Longosoma cf. catalinensis* Hartman 1944

Knox 1960C — NZ 39/177/t,o,d

ORBINIIDAE

Haploscoloplos fragilis (non Verrill 1873)

lost Anderson 1960 — NSW 33/151/i — indeterminate — fide Day 1977

Leitoscoloplos bifurcatus (Hartman 1957) — fide Day 1977

Day 1977 — VIC 38/144/t; NSW 35/151/o; 34/151/t; QLD 27/153/t; NT
13/130/?i

AM,AHM as *Haploscoloplos bifurcatus* Hartman 1957 — SA 34/137/i; 34/139/i; NSW
33/151/t

Stephenson et al., 1974 — QLD 27/153/t

Leitoscoloplos kerguelensis (McIntosh 1885)

non *Haploscoloplos kerguelensis* Monro 1936 — WA 32/115/e

Knox 1965, Knox and Cameron 1971 — VIC 38/144/i,t; NZ 44/167/d

AM *Leitoscoloplos latibranchus* Day 1977 — SA 35/139/e

AM *Leitoscoloplos normalis* Day 1977 — WA 34/115/e; VIC 38/145/t; NSW 32/152/e;
33/151/i; 34/150/i; QLD 27/153/i

- Naineris grubei* (Gravier 1909)
Day 1977 — Lord Howe Is. 31/159/i
- AHM *Naineris grubei australis* Hartman 1957 — SA 34/137/i; 35/139/i
Day 1977 — VIC 38/144/t; NSW 35/150/?i; NZ 41/174/o
- Naineris laevigata* (Grube 1855)
Day 1977 — WA 32/115/i; VIC 38/145/t
as *Scoloplos (Naidonereis) hexaphyllum* (Schmarda 1861)
Augener 1926, 1927A — NSW 33/151/i; NZ 34/172/i,o
- AM *Naineris victoriae* Day 1977 — VIC 38/145/t
- AM *Orbinia hartmani* Day 1977 — NSW 33/151/o; QLD 27/153/t
- Orbinia papillosa* (Ehlers 1907)
Knox 1965, Estcourt 1967, Wood 1968, Day 1977 — VIC 38/145/t; NZ 36/174/e,i; 43/172/e,i; 44/167/d
- BM as *Aricia papillosa* Ehlers 1907 — NZ 36/174/?
- ?SSM *Phylo felix* Kinberg 1866
Day 1977 — VIC 38/145/t; NSW 33/151/o; QLD 27/153/t
as *Aricia michaelsoni* Ehlers 1897
Augener 1924A — Auckland Is. 50/166/o
- Phylo fimbriatus* (Moore 1903)
Day 1977 — VIC 38/145/t
- NZOI,AM *Phylo novaezealandiae* Day 1977 — NZ 40/173/e,t; 41/172/d; 41/174/d
- AM *Scoloplos (Leodamas) dendrocirris* Day 1977 — NSW 33/151/o
- AHM *Scoloplos (Leodamas) fimbriatus* Hartman 1957 — SA 35/136/i
Day 1977 — VIC 38/145/t
- Scoloplos (Leodamas) johnstonei* Day 1934
Day 1977 — VIC 38/145/t; NSW 34/150/t; QLD 27/153/t
- Scoloplos (Leodamas) ohlini* (Ehlers 1900) — fide Hartman 1957
as *Scoloplos ohlini* Augener 1926 — NZ 37/177/o
- Scoloplos (Scoloplos) armiger* (Müller 1776)
Day 1977 — WA 33/115/i,t; VIC 38/145/t; NSW 33/151/o
non *Scoloplos armiger* Augener 1914 — WA 25/113/i — indeterminate
non *Scoloplos armiger* Rullier 1965 — QLD 17/153/i (= *Leitoscoloplos normalis* Day)
- BM,HZM *Scoloplos (Scoloplos) cylindriker* Ehlers 1904, 1905 — NZ 40/173/?
Chatham Is.(?)
Augener 1914, 1926, 1927B, Benham 1950, Estcourt 1967, 1968, Day 1975, 1977 — WA 32/115/e; SA 35/135/t; 35/138/i; VIC 35/138/i; Walkerville; 38/146/?; 34/134/?i; 35/139/e; NSW 32/152/e; 33/151/i; 34/150/i; 35/150/t; NZ 40/173/?

- AHM as *Scoloplos (Leodamas) dendrobranchus* Hartman 1957 — fide Day 1975
— SA 35/138/i; 35/139/i
- AM *Scoloplos (Scoloplos) difficilis* Day 1977 — WA 32/115/e; SA 35/138/e; VIC 37/149/e; Nungurner; 37/147/e; 38/144/e; NSW 30/152/i; 32/152/e; 35/150/i; 36/150/i; QLD 27/153/t
- Scoloplos (Scoloplos) novaehollandiae* (Kinberg 1866) — fide Augener 1922C
Day 1977 — NSW 33/151/i; QLD 25/152/i
- SSM as *Labotas Novae Hollandiae* Kinberg 1866B — NSW 33/151/t
- as *Scoloplos novae-hollandiae* Augener 1922C, 1927A — NSW 37/149/t
- Scoloplos (Scoloplos) simplex* (Hutchings 1974) — fide Day 1977
Day 1977 — WA 34/115/e; 32/115/e; VIC 38/143/?; 38/145/i; Cannons
Creek; NSW 32/152/e; 30/153/i; 32/152/e; 33/151/e; QLD 27/153/i,?;
25/152/i
- as *Haploscoloplos kerguelensis* (non McIntosh) Knox 1965 — NZ 44/167/t
- AM as *Haploscoloplos simplex* Hutchings 1974 — NSW 32/152/e
- Scoloplos* sp. Wood 1968 — NZ 36/174/i

PARAONIDAE

- Aedicireia* sp. Poore et al., 1975 — VIC 38/144/t
- Aricidea fauveli* Hartman 1957
Poore et al., 1975 — VIC 38/144/t
- Aricidea suecica* cf. *simplex* Day 1963
Poore et al., 1975 — VIC 38/144/t
- Paraonis dubius* (Augener 1914) — fide Augener 1924A
as *Scoloplos (Naidonereis) dubius* Augener 1914 — WA 25/113/t
- Paraonis gracilis gracilis* (Tauber 1879)
Poore et al., 1975 — VIC 38/144/t

OPHELIIDAE

- Armandia intermedia* Fauvel 1902
Hutchings 1974, Stephenson et al., 1974, Hutchings and Recher 1974
— NSW 33/151/i; ?QLD 27/153/t
- as *Armandia lanceolata* Willey 1905
Augener 1914, 1922B, 1927A, Fauvel 1917, 1922, Monroe 1931, Knox
and Cameron 1971 — WA 19/120/t; 25/113/t; 32/115/e,i,t; 35/117/t; SA
34/138/?; VIC 38/144/t; 38/145/t
- Armandia maculata* (Webster 1884)
Augener 1924A, 1926, 1927B, Benham 1950, Knox 1965, Estcourt 1967
— NZ 36/174/t; 37/176/t; 39/177/o; 43/172/e; 44/167/t; 47/169/t;
Auckland Is. 50/166/t,o; Campbell Is. 52/169/t
- Armandia* sp. Stephenson et al., 1974 — QLD 27/153/t

- Euzonus otagoensis* Probert 1976 — NZ 45/170/i
- MNHN *Ophelia ashworthi* Fauvel 1917 — SA 34/137/?; 34/138/?
- AM *Ophelia dannevigii* Benham 1916B — SA 32/133/o
- Ophelia breviata* (Ehlers 1913)
Augener 1927A — NSW 37/150/o
- Ophelina gigantea* (Rullier 1965)
- AM as *Ammotrypane gigantea* Rullier 1965 — QLD 27/153/t
- Polyophthalmus pictus* (Dujardin 1839)
Augener 1914, 1927A, Fauvel 1922, Stephenson et al., 1974, Poore et al., 1975 — WA 25/113/t; 28/113/i; 32/114/i,t; 33/115/t; 35/117/t; VIC 38/144/t; NSW 34/150/i; QLD 27/153/t
- as *Polyophthalmus australis* Grube 1869 — QLD 10/142/?
- Travisia forbesi* Johnston 1840
Ehlers 1904, 1907, Poore et al., 1975 — VIC 38/144/t; NZ 43/172/?
- BM *Travisia kerguelensis* McIntosh 1885
Augener 1924A, 1926 — NZ 36/175/o; 41/174/t; 43/172/t; Auckland Is. 50/166/o
- SSM *Travisia lithophila* Kinberg 1866B — NSW 33/151/t
- Travisia olens* Ehlers 1897
Ehlers 1907, Benham 1950, Wood 1968 — NZ 36/174/i; 43/169/?; Auckland Is. 50/166/i
- BM *Travisia olens* var. *novaezealandiae* Benham 1927 — NZ 36/174/?; 43/172/?

SCALIBREGMIDAE

- NMV *Asclerocheilus heterochaetus* Kudenov and Blake 1978 — VIC 38/144/t; 38/145/t
- Hyboscolex dicranochaetus* (Schmarda 1861) — NSW 33/151/i emended Kudenov and Blake 1978.
Kudenov and Blake 1978 — WA 31/151/i; SA 32/137/e; VIC 37/144/i; NSW 29/153/i; 33/151/e; 33/151/i; 34/151/i; 34/150/i
- as *Hyboscolex longiseta* (non Schmarda)
Hutchings 1974 — NSW 32/151/e
- Hyboscolex longiseta* Schmarda 1861
Augener 1924A, 1926 — NZ 34/172/o; 35/174/i; 36/174/i; 36/175/o; Auckland Is. 50/166/i
- as *Oncoscolex dicranochaetus* (non Schmarda)
Ehlers 1904, 1905 — Chatham Is.
- ?NMV as *Oncoscolex homochaetus* Schmarda 1861 — New Zealand
- AM *Oligobregma oculata* Kudenov and Blake 1978 — QLD 28/167/t
- NMV *Oligobregma simplex* Kudenov and Blake 1978 — VIC 38/145/t

Pseudoscalibregma parvum (Hansen 1878)

BM as *Eumenia reticulata* McIntosh 1885 — NZ 40/177/a — fide Furreg 1925 and Day 1961

Scalibregma inflatum Rathke 1843

Knox 1965, Kudenov and Blake 1978 — VIC 38/145/t; QLD 27/153/t; NZ 44/167/d

ARENICOLIDAE

Abarenicola affinis affinis (Ashworth 1903)

Wells 1963, Estcourt 1967, Wood 1968 — NZ 37/174/i; 41/174/i; 43/172/i,e,t; 45/170/i; 47/169/i

BM as *Arenicola assimilis* var. *affinis* Ashworth 1903 — TAS (north coast) Stach 1944B — VIC 38/145/i

BM *Abarenicola affinis clarki* Wells 1963 — TAS 42/147/i

BM *Abarenicola affinis devia* Wells 1963 — VIC 38/145/i; 38/144/i

BM *Abarenicola assimilis haswelli* Wells 1963 — TAS 40/145/i; 42/147/i

BM *Abarenicola assimilis insularum* Wells 1963 — Campbell Is. 52/169/i

Arenicola bombayensis Kewelrami, Waugh and Ramade 1959

Wells 1962, Hutchings 1974, Hutchings and Recher 1974 — WA 20/115/i; NSW 32/152/e; 33/151/i

as *Arenicola cristata* (non Stimpson) — fide Wells 1962
Ashworth 1912, Augener 1914 — "North West Australia"

Arenicola claparedi Levinsen 1883

Ehlers 1907 — NZ 45/170/i

Arenicola cristata Stimpson 1856

Wells 1962 — WA 28/115/i

Arenicola loveni sudaustaliense Stach 1944B — SA 34/136/i

Wells 1962 — SA 34/136/i; 35/137/i; 35/138/i

as *Arenicola loveni* Ashworth 1916 — SA 35/137/i

CAPITELLIDAE

AM *Barantolla lepte* Hutchings 1974 — NSW 32/152/e
Hutchings and Recher 1974 — NSW 33/151/i

AM *Bucherta lumbricoides* Rullier 1965 — QLD 27/153/i

Bucherta sp. Stephenson et al., 1974 — QLD 27/153/t

Capitella capitata (Fabricius 1780)

Augener 1914, Estcourt 1967, Hutchings and Recher 1974 — WA 25/113/t; 32/115/i; 33/115/t; NSW 33/151/i; NZ 43/172/e

Capitella perarmata Gravier 1911 — fide Hartman 1959

- as *Isomastus perarmatus* Augener 1926 — NZ (on *Callorhynchus* eggs, ?locality)
- Capitellethus dispar* (Ehlers 1907) — fide Hartman 1959
Rullier 1965, Poore et al., 1975 — VIC 38/144/t; QLD 27/153/i
- BM,HZM as *Capitellides dispar* Ehlers 1907 — NZ 36/174/i
- OM as *Notomastus eisigi* Benham 1916B — fide Hartman 1959 — SA 32/113/o
as *Notomastus zeylanicus* Willey 1905 — fide Hartman 1959
Augener 1926, 1927A — NZ 37/153/o; 47/169/t
- BM *Dasybranchethus fauveli* Monro 1931 — QLD 16/145/?
Dasybranchus caducus (Grube 1846)
Augener 1922A, Rullier 1965, Stephenson et al., 1974 — QLD 19/149/i;
27/153/i,t
- BM *Dasybranchus* sp. Monro 1931 — QLD 16/145/i
- HZM *Heteromastides bifidus* Augener 1914 — WA 32/115/t
Heteromastus filiformis (Claparède 1864)
Estcourt 1967 — NZ 43/172/e
- HZM *Leiochrides australis* Augener 1914 — WA 25/113/t; 32/115/i; 33/115/t
Notomastus giganteus Moore 1906
Rullier 1965 — QLD 27/153/t
Notomastus (Clistomastus) hemipodus Hartman 1947
Hutchings 1974, Hutchings and Recher 1974 — NSW 32/152/e;
33/151/i
Notomastus sp. Knox 1965 — NZ 44/167/t,d
Estcourt 1968 — NZ 40/174/d
Pseudocapitella sp. Stephenson et al., 1974 — QLD 27/153/t
Scyphoproctus djiboutiensis Gravier 1904
Hutchings 1974 — NSW 32/152/e

MALDANIDAE

- Asychis amphiglypta* (Ehlers 1897)
Ehlers 1907, Augener 1926 — NZ 36/174/?; 39/177/o
- NMV *Asychis glabra* Knox and Cameron 1971 — VIC 38/144/t
Poore et al., 1975 — VIC 38/144/t
- HZM *Asychis theodori* Augener 1926 — NZ 36/175/o; 37/177/d; 38/174/o; 41/174/?
- HZM *Asychis trifilosa* Augener 1926 — NZ 36/174/t; 39/177/o
- AM *Asychis victoriae* Benham 1916B — VIC 40/141/a
- HZM *Axiothella australis* Augener 1914 — WA 25/113/t; 32/115/i
- HZM *Axiothella quadrimaculata* Augener 1914 — WA 25/113/t, Augener 1924A,
1926, 1927A — NSW 37/150/o; NZ 34/172/o; 39/173/t; Auckland Is.
50/166/i; Campbell Is. 52/169/0

NMNZ, NMV, AM, AHF

Axiiothella serrata Kudenov and Read 1978 — NZ 41/175/i

Clymenella insecta (Ehlers 1904)

Ehlers 1905 — Chatham Is. (?)

as *Clymene insecta* Ehlers 1904 — Chatham Is. (?)

as *Praxillella insecta* Augener 1926 — NZ 36/175/o; 45/170/?

Clymenella sp. Augener 1914 — WA 32/115/t; 33/115/i

Clymenura sp.

HZM as *Leiochone* sp. Augener 1914 — WA 32/115/t

KM *Euclymene aucklandica* Augener 1924A — Auckland Is. (?)

Augener 1926 — NZ 39/177/?; 43/172/t

= *Maldanella neozealandiae* — fide Fyfe 1952

AM *Euclymene trinalis* Hutchings 1974 — NSW 32/152/e

CM *Euclymene* sp. Knox 1965 — NZ 44/167/d

Stephenson et al., 1974 — QLD 27/153/t

HZM *Macroclymenella stewartensis* Augener 1926 — NZ 47/168/i

Maldane sarsi var. *antarctica* Arwidsson 1911

Augener 1927A — VIC 38/144/t

BM *Maldanella neozealandiae* McIntosh 1885 — NZ 40/177/a

KM *Nicomache plimmertonensis* Augener 1926 — NZ 41/174/i

Nicomache sp. Augener 1926 — NZ 41/174/t

HZM *Notoproctus godeffroyi* Augener 1922A — QLD 19/148/?

Petaloproctus terricola Quatrefages 1865

Rullier 1965, Stephenson et al., 1974, Poore et al., 1975 — VIC 38/144/t; QLD 27/153/i,t

Petaloproctus integrinatis (Haswell 1883B) — fide Hartman 1959

lost as *Clymene integrinatis* Haswell 1883B — NSW 33/151/i

Pope 1943 — NSW 33/151/i

Rhodine intermedia Arwidsson 1911

Augener 1926 — NZ 36/175/o

OWENIIDAE

?*Myriochele* sp. Knox 1965 — NZ 44/167/d

Owenia fusiformis delle Chiaje 1844

Haswell 1883B, Ehlers 1907, Augener 1914, 1922B, 1926, 1927A, 1927B, Benham 1916B, Rullier 1965, Estcourt 1968, Hutchings 1974, Hutchings and Recher 1974, Poore et al., 1975 — WA 19/120/t; 25/113/t; VIC 38/144/t; NSW 32/152/e; 33/151/i; 35/150/t; QLD 27/153/i; NZ 36/175/o; 37/176/t; 37/177/d; 40/174/d; 41/174/t; 43/172/?; 45/170/?

- lost as *Ammochares tenuis* Haswell 1883B — NSW 33/151/i — fide Hutchings 1974

STERNASPIDAE

Sternaspis scutata (Renier 1807)

Benham 1916A, 1916B, Augener 1926, Stephenson et al., 1974 — SA 37/137/o; QLD 27/153/t; NZ 39/176/o; 43/172/t

Sternaspis princeps Selenka 1885 — NZ 37/179/a

FLABELLIGERIDAE

Brada gravieri McIntosh 1922 — "South of Australia"

BM *Brada whiteavesii* McIntosh 1885 — NZ 41/174/?

Brada sp. Knox 1965 — NZ 44/167/d

AM *Bradiella branchiata* Rullier 1965 — QLD 27/153/t

lost *Coppingeria longisetosa* Haswell 1892 — QLD 20/148/t
Fauvel 1917, Rullier 1965, Stephenson et al., 1974 — SA 34/138/?; QLD 10/142/?; 27/153/t

Diplocirrus cf. *capensis* Day 1961

Stephenson et al., 1974 — QLD 27/153/t

Diplocirrus sp. 2. Stephenson et al., 1974 — QLD 27/153/t

Flabelligera affinis Sars 1829

Augener 1926, 1927A — NSW 33/151/i; NZ 34/172/o; 34/173/i

as *Siphonostoma affine* Haswell 1886 — NSW 33/151/t

Flabelligera bicolor (Schmarda 1861)

Benham 1915B, 1950 — Kermadec Is. 30/178W/?; NZ 36/174/i;
Chatham Is. (?); Auckland Is. 50/166/i

?ZUW as *Pherusa bicolor* Schmarda 1861 — "New Zealand" (t)

as *Chloraema bicolor* Quatrefages 1865 — record repeated

= *Flabelligera affinis* Sars — fide Augener 1926

BM, HZM as *Flabelligera lingulata* Ehlers 1904 — fide Hartman 1959, Ehlers 1904, 1905 — Chatham Is. (?), Ehlers 1907 — NZ 41/173/?i

Pherusa cincta (Haswell 1883) — fide Hartman 1959

lost as *Stylarioides cinctus* Haswell 1883B — NSW 33/151/t

Pherusa horsti (Haswell 1883) — fide Hartman 1959

lost as *Stylarioides horsti* Haswell 1883B, 1892 — NSW 33/151/t

as *Stylarioides kerguelarum* (non McIntosh) Augener 1922 (partim) — WA 35/117/t

as *Stylarioides plumosus* var. *horsti* Augener 1926, 1927A — VIC 38/145/t;
NSW 33/151/t; NZ 47/169/t

Pherusa parmata (Grube 1878)

as *Stylarioides parmatus* Ehlers 1907, Augener 1926, 1927B — NZ
36/174/e,i; 36/175/o; 37/176/t; 39/173/t

Piromis cf. *arenosus* Kinberg 1867

Stephenson et al., 1974 — QLD 27/153/t

Piromis sp. 2. Stephenson et al., 1974 — QLD 27/153/t

SABELLARIIDAE

Idanthysus armatus Kinberg 1857

Day 1975 — WA 32/115/i,t

Idanthysus pennatus (Peters 1854)

Fauvel 1917, Pope 1943 — SA 32/133/i; NSW 33/151/i, t

?ZUW

as *Hermella quadricornis* Schmarda 1861 — NZ 36/174/i

as *Pallasia quadricornis* Ehlers 1904, 1907, Augener 1926 — NZ 36/174/?;
47/169/i

lost

as *Sabellaria* (*Hermella*) *australiensis* Haswell 1883B — QLD 10/142/?

as *Sabellaria* (*Pallasia*) *pennata* Augener 1914 — WA 25/113/t

as *Sabellaria sexhamata* Collin 1902 — QLD 10/142/?

as *Pallasia pennata* Augener 1922A, 1927A — NSW 33/151/i; QLD 10/142/i

BM

Lygdamis giardi (McIntosh 1885) — fide Johansson 1927

as *Sabellaria* (*Pallasia*) *giardi* McIntosh 1885 — NSW 36/150/d

as *Eupallasia giardi* Augener 1927A — VIC 38/149/o; NSW 37/150/o

as *Tetreres intoshi* Caullery 1913 — NSW 33/151/?

Lygdamis cf. *indicus* Kinberg 1867

Stephenson et al., 1974 — QLD 27/153/t

Phragmatopoma lapidosa Kinberg 1867 — fide Johansson 1927

as *Sabellaria castelnaui* (Grube) Augener 1926 — "New Zealand"

KM

Sabellaria antipoda Augener 1926 — NZ 37/176/t

Augener 1927A — NZ 38/174/o

as *Sabellaria* (*Phragmatopoma*) *antipoda* Monro 1936 — NZ 35/172/o

HZM

Sabellaria kaiparaensis Augener 1926 — NZ 34/174/i; 36/174/i; 43/172/?;
47/169/o

KM

Sabellaria rupicaproides Augener 1926 — NZ 39/173/t

AMPHICTENIDAE (=PECTINARIIDAE auctorum)

fide Lucas and Holthius 1975 — see note added in press

Amphictene crassa (Grube 1870)

Hartman 1966 — ?NSW (locality unknown)

- ?ZUW *Cistena antipoda* (Schmarda 1861) — fide Lucas and Holthius 1975
 as *Pectinaria antipoda* Schmarda 1861 — NSW 33/151/i
 Monro 1931, Knox and Cameron 1971, Stephenson *et al.*, 1974, Poore *et al.*, 1975 — VIC 38/144/t; 38/145/t; QLD 16/145/?; 27/153/t
 as *Cistenides antipoda* Augener 1927A — NSW 36/150/t; 38/150/o
- BM, HZM *Pectinaria (Lagis) australis* Ehlers 1904 — NZ 43/172/?
 Wear 1966, Estcourt 1967, 1974 — NZ 36/174/i; 41/173/t; 41/174/i; 43/172/e
 as *Lagis australis* Augener 1926, 1927B — NZ 36/174/i; 37/176/i; 38/174/o; 43/172/?
- Cistena brevispinis* (Grube 1878)
 as *Pectinaria brevispinis* Monro 1931 — QLD 16/145/i
- CM *Cistena* sp.
 as *Pectinaria* sp. Knox 1965 — NZ 44/167/d

AMPHARETIDAE

- Ampharete kerguelensis* McIntosh 1885
 Augener 1926 — NZ 43/172/?
- Amphicteis gunneri* (Sars 1835)
 Stephenson *et al.*, 1974 — QLD 27/153/t
- Amphicteis philippinarum* Grube 1878
 Augener 1922B, 1926, Monro 1936 — WA 19/120/t; NZ 34/172/d; 35/172/o; 35/173/o; 36/175/o; 41/174/o
- Anobothrus patagonicus* (Kinberg 1867) — fide Benham 1927
 as *Sosane patagonicus* Augener 1926 — NZ 36/175/o; 38/174/o
- AM *Auchenoplax mesos* Hutchings 1977 — QLD 27/153/t
 as *Auchenoplax* sp. Stephenson *et al.*, 1974 — QLD 27/153/t
- Isolda pulchella* Müller 1858
 Stephenson *et al.*, 1974, Hutchings 1977, Poore *et al.*, 1975 — VIC 38/144/t; QLD 27/153/t
- HZM *Isolda warnbroensis* Augener 1914 — WA 33/115/t
- BM *Melinna armandi* McIntosh 1885 — NZ 40/177/a
 as *Melinna cristata* var. *armandi* Augener 1926 — NZ 36/175/o
- CM *Melinna* sp. Knox 1965 — NZ 44/167/d
- Phyllamphicteis foliata* (Haswell 1883) — fide Augener 1927A
 Augener 1927A — VIC 38/145/t; NSW 37/149/t
- lost as *Amphicteis foliata* Haswell 1883B — QLD 20/149/t
- AM *Pseudoamphicteis papillosa* Hutchings 1977 — QLD 27/153/t; 20/148/?
- ?MNHN *Rytocephalus ebranchiatus* Quatrefages 1865 — NSW 35/150/o
 indeterminate = ?*Amphicteis* sp. — fide Hartman 1959

TRICHOBRANCHIDAE

- NMV *Artacamella dibranchiata* Knox and Cameron 1971 — VIC 38/144/t
fide Hutchings 1977
Hutchings 1977, Poore et al., 1975 — VIC 38/145/t; QLD 27/153/t
as *Trichobranchus glacialis* (non Malmgren) — fide Hutchings 1977
Stephenson et al., 1974 — QLD 27/153/t
- Terebellides stroemii* Sars 1835
Augener 1924A, 1926, 1927A, Rullier 1965, Knox 1965, Knox and
Cameron 1971, Stephenson et al., 1974, Poore et al., 1975, Hutchings
1977 — VIC 38/144/t; 38/145/t; NSW 37/150/o; QLD 27/153/i, t; NZ
36/174/?; 36/175/o; 37/177/o; 43/172/t; 44/167/t; Auckland Is. 50/166/o
as *Terebellides? sieboldi* Kinberg 1866B — fide Fyfe 1952
Ehlers 1904 — NZ 43/172/?
- ?BM *Terebellides* sp. McIntosh 1885 — NZ 37/179/a
Augener 1914 — WA 32/115/t; 33/115/t

TEREBELLIDAE

- KM *Amaeana antipoda* (Augener 1926) — fide Hartman 1959
as *Amaea antipoda* Augener 1926 — NZ 43/172/?
- Amaeana trilobata* (Sars 1863)
Stephenson et al., 1974, Poore et al., 1975, Hutchings 1977 — VIC
38/145/t; QLD 27/153/t; 25/153/t
- Amphitrite modesta* (Quatrefages 1865) — fide Hartman 1959
?MNHN as *Terebella modesta* Quatrefages 1865 — NSW 35/150/?
Whitelegge 1889 — NSW? 33/151/i
- Amphitrite rubra* (Risso 1828)
Fauvel 1917, Rullier 1965, Knox and Cameron 1971, Stephenson et
al., 1974, Poore et al., 1975, Hutchings 1977 — SA 34/138/?; VIC
38/144/i, t; 38/145/t; QLD 27/153/i, t
- BM as *Amphitrite vigintipes* Grube 1869 — fide Hartman 1959
Ehlers 1907; Augener 1926, 1927A — VIC 38/148/d; NZ 34/172/o;
35/174/i; 36/175/t, o; 45/170/?; 47/169/i
as *Amphitrite virginites* (sic) Knox 1951B — NZ 40/173/d
- Axionice harrissoni* (Benham 1916)
Knox and Cameron 1971 — VIC 38/144/t
- OM as *Scione harrissoni* Benham 1916B — SA 36/137/o
- BM *Bathya neozealandiae* (McIntosh 1885)
as *Leaena neo-zealandiae* McIntosh 1885 — NZ 40/177/a
- BM *Bathya sarsi* (McIntosh 1885) — fide Hartman 1959
as *Lanassa sarsi* McIntosh 1885 — NZ 37/179/a
- AM *Decathelepus ocellatus* Hutchings 1977 — QLD 27/153/t
as *Telothelepus* sp. Stephenson et al., 1974 — QLD 27/153/t

- Eupolymnia nebulosa* (Montagu 1818)
Knox and Cameron 1971 — VIC 38/144/i, t
as *Polymnia nebulosa* Fauvel 1917 — SA 34/137/?; 38/138/?
- Eupolymnia trigonostoma* (Schmarda 1861)
Poore et al., 1975 — VIC 38/144/t
- ?ZUW as *Terebella trigonostoma* Schmarda 1861 — NSW
as *Polymnia trigonostoma* Augener 1914, 1922A, 1927A — WA 32/115/t;
35/117/t; VIC 38/145/t; QLD 19/148/?
- BM as *Terebella grubei* McIntosh 1885 — fide Hartman 1959 — NSW 33/151/o;
36/150/d
?= *Polymnia nebulosa* — fide Fauvel 1917
- Eupolymnia* (?) *kermadecensis* (McIntosh 1885) — fide Hartman 1959
- BM as *Terebella kermadecensis* McIntosh 1885 — Kermadec Is. 28/177/a
- AM *Hadrachaeta aspeta* Hutchings 1977 — QLD 27/153/t; NSW 30/151/i; 34/151/i
- Lanice conchilega* (Pallas 1766)
Benham 1909, Augener 1926, 1927A, 1927B, Knox and Cameron 1971,
Stephenson et al., 1974, Hutchings 1977 — VIC 38/144/t; 38/145/t;
?NSW 37/150/o (tube only); QLD 27/153/t; NZ 34/172/o; 34/173/d;
36/174/i; 36/176/?; 37/176/t; 46/170/o; 47/168/o
as *Lanice conchylega* (sic) Ehlers 1907 — NZ 43/169/?
- Lanice flabellum* Baird 1865 (tubes only; indeterminate) — fide Hartman
- BM as *Terebella* (*Lanice*) *flabellum* Baird 1865B — NSW 33/151/t
Benham 1927 — NZ 34/172/d
- BM *Leaena langerhansi* McIntosh 1885 — NZ 40/177/a
- AM *Litancyra octoseta* Hutchings 1977 — NSW 33/152/t; QLD 27/153/t
- Loimia ingens* (Grube 1878)
Stephenson et al., 1974, Hutchings 1977 — NSW 34/151/i; QLD
16/145/i; 27/153/t
as *Loimia cf. ingens* Hartman 1966 — NSW 33/151/i
- Loimia medusa* (Savigny 1818)
Augener 1922B, 1927A, Rullier 1965, Stephenson et al., 1974,
Hutchings 1977 — WA 19/120/t; NSW 33/151/i, t; QLD 27/153/t
as *Loimia montagui* (Grube 1878) — Homonym — fide Rullier 1965
Monro 1931 — QLD 14/145/t
- Loimia ochracea* Grube 1878
as *Terebella* (*Loimia*) *ochracea* Grube 1878A — WA 17/119/?
- AM *Lysilla apheles* Hutchings 1974 — NSW 32/152/e
Hutchings 1977 — QLD 27/153/t
as *Lysilla* sp. Stephenson et al., 1974 — QLD 27/153/t

as ?*Polycirrus boholensis* Rullier 1965 — QLD 27/153/t

Lysilla loveni macintoshi Gravier 1907

as *Lysilla macintoshi* Augener 1924A — Auckland Is. 50/166/i

Lysilla pacifica Hessle 1917

Hutchings 1974, 1977, Hutchings and Recher 1974 — NSW 33/151/i;
32/152/e; QLD 27/153/t

Lysilla sp. Knox 1965 — NZ 44/167/d

Neoamphitrite affinis (Malmgren 1866)

as *Amphitrite? intermedia* Malmgren 1866
Ehlers 1905 — NZ 39/177/?

Nicolea bilobata (non Grube 1878) — fide Hessle 1917

Augener 1914 — WA 25/113/t; 29/114/t

Nicolea chilensis (Schmarda 1861)

Augener 1926, 1927B, Monro 1936, Knox 1951B — NZ 34/172/o;
34/173/?; 35/175/o; 36/174/o; 36/175/o; 37/176/i, t; 39/173/t; 47/169/i

HZM

Nicolea maxima Augener 1924A — Auckland Is. 50/166/t

Augener 1926, Knox 1951B, Benham 1915B — NZ 36/174/i; 43/172/t;
45/170/?; Auckland Is. 50/166/i, t

as *Nicolea gracilibranchis* (non Grube)

Ehlers 1907 (partim) — NZ 45/170/?

Nicolea venustula (Montagu 1818)

as *Nicolea gracilibranchis* (Grube 1878) — fide Day 1973

Ehlers 1907 (partim) — NZ 45/170/?

Nicolea sp. Knox 1951A — NZ 44/167/d

Pista cetrata (Ehlers 1887) — fide Augener 1927A and Day 1967

as *Nicolea cetrata* (Ehlers 1887)

Augener 1927A — VIC 38/145/t

Pista cristata (Müller 1776)

Poore et al., 1975 — VIC 38/144/t

AM

Pista pectinata Hutchings 1977 — QLD 27/153/t

as *Pista* sp. 1. Stephenson et al., 1974 — QLD 27/153/t

AM

Pista trina Hutchings 1977 — QLD 27/153/t

as *Pista* sp. 3. Stephenson et al., 1974 — QLD 27/153/t

AM

Pista trunca Hutchings 1977 — QLD 27/153/t

as *Pista* sp. 2. Stephenson et al., 1974 — QLD 27/153/t

Pista typha Grube 1878

Augener 1927A, Monro 1931, Knox and Cameron 1971, Stephenson
et al., 1974, Poore et al., 1975, Hutchings 1977 — VIC 38/144/t; NSW
37/149/t; QLD 16/145/i; 27/153/t

Pista sp. Hutchings 1974 — NSW 32/152/e

Polycirrus boholensis Grube 1878

Augener 1914 — WA 25/113/t; 32/115/t

- BM *Polycirrus kerguelensis* McIntosh 1885
Augener 1924A, 1926 — NZ 36/175/o; Auckland Is. 50/166/i
Polycirrus nervosus Marenzeller 1884
Augener 1926 — ?NZ 45/170/?
- NMV *Polycirrus porcatus* Knox and Cameron 1971 — VIC 38/144/t
- AM *Reteterebella queenslandia* Hartman 1963 — QLD 23/150/i
- AM *Rhinothelepus lobatus* Hutchings 1974 — NSW 32/152/e
Hutchings and Recher 1974 — NSW 33/151/i
- AM *Rhinothelepus macer* Hutchings 1977 — QLD 27/153/t
- ZMA *Streblosoma amboinense* Caullery 1944
Hutchings 1974, 1977 — NSW 32/152/e; QLD 27/153/t
- ZMA *Streblosoma gracile* Caullery 1944
Hutchings 1977 — QLD 27/153/t
as *Streblosoma* sp. Stephenson et al., 1974 — QLD 27/153/t
Terebella haplochaeta (Ehlers 1904)
Knox and Cameron 1970 — NZ 48/166/i
- HZM as *Leprea haplochaeta* Ehlers 1904, 1905 — Chatham Is.
Augener 1913, 1914, Benham 1927, 1950 — WA 25/113/i; 32/115/t;
35/117/t; NZ 34/173/i; Auckland Is. 50/166/i
as *Leprea (Terebella) haplochaeta* Augener 1924A, 1926, 1932 — NZ
34/173/i; 36/174/i; 45/170/?; 47/169/?; Auckland Is. 50/166/i; Campbell
Is. 52/169/i
Terebella stenotaenia Grube 1872 — QLD 27/153/?
Thelepus plagiostoma (Schmarda 1861)
Augener 1914, 1922B, 1924A, 1926, 1927B, Benham 1950, Knox 1951B,
Rullier 1965, Hutchings 1977 — WA 19/120/t; 20/118/i; QLD 27/153/t;
NZ 34/173/i; 35/174/i; 37/176/i, t; 40/173/d; 41/174/t; 43/172/i;
Auckland Is. 50/166/t
- ?ZUW as *Terebella plagiostoma* Schmarda 1861 — New Zealand
as *Thelepus rugosus* Ehlers 1901
Ehlers 1904, 1905, — Chatham Is.
- ?ZUW as *Terebella heterobranchia* Schmarda 1861 — fide Augener 1914 — New
Zealand
?as *Thelepus spectabilis* Ehlers 1897 — fide Hartman 1959
Augener 1926, ?Wood 1968 — NZ 36/174/?; 47/169/t
Thelepus robustus (Grube 1878)
Hutchings 1977 — NSW 34/151/i; QLD 11/141/i; 23/151/i; 27/153/i
Thelepus setosus (Quatrefages 1865)
Fauvel 1917, Knox and Cameron 1971, Hutchings and Recher 1974,
Poore et al., 1975 — SA 34/138/?; VIC 38/144-5/t; NSW 33/151/i

AUST. and N. Z. POLYCHAETA, ARCHIANNELIDA AND MYZOSTOMIDA 140

as *Thelepus thoracicus* Grube 1870 — fide Fauvel 1917
Augener 1914, 1922B — WA 19/120/t; 33/115/t; 35/117/t

SABELLIDAE

Amphiglena mediterranea (Leydig 1851)
Augener 1914, Poore et al., 1975 — WA 25/113/t; 29/114/t; 32/115/t;
33/115/t; VIC 38/144/t

HZM *Branchiomma galei* (Augener 1914) — fide Johansson 1927
as *Dasychone galei* Augener 1914 — WA 19/114/i

Branchiomma nigromaculata (Baird 1865) — fide Day 1955
as *Dasychone cingulata* Grube 1878
Augener 1914, 1927A, Knox and Cameron 1970 — WA 25/113/t;
32/115/t; 33/115/t; 35/117/t; VIC 38/144/i, t; 39/149/o; NZ 47/168/o

as *Dasychone curta* Ehlers 1906
Ehlers 1907, Benham 1927 — NZ 34/173/t; 45/170/?i; 47/169/?

as *Dasychone cingulata* var. *curta* Augener 1926, 1932 — NZ 34/172/i;
43/172/t; 47/169/o; Campbell Is. (i)

as *Branchiomma cingulata* Knox and Cameron 1971, Hutchings 1974 —
VIC 38/144/i, t; NSW 32/152/e

Branchiomma serratibranchis (Grube 1878) — fide Johansson
as *Dasychone serratibranchis* Ehlers 1907, Benham 1909, Augener 1926 —
NZ 36/174/?; 43/172/?; 46/170/o

SSM *Demonax leucaspis* Kinberg 1867
Monro 1938 — WA 32/115/e

Desdemona sp. — fide Banse 1957
as *Oithona sabella* Augener 1914 (partim) — WA 26/113/e

HZM *Eudistylia brevicomata* (Ehlers 1905) — fide Hartman 1959
as *Sabella* (*Potamilla*) *brevicomata* Ehlers 1905 — NZ 39/177/i

?ZUW *Eudistylia ceratodaula* (Schmarda 1861) — fide Hartman 1959
as *Sabella ceratodaula* Schmarda 1861 New Zealand

as *Laonome ceratodaula* Ehlers 1904, 1907 — NZ (repeat)

BM ?as *Sabella grandis* Baird 1865B — New Zealand
= *Sabellastarte indica* (Savigny) — fide Augener 1927A

Euchone pallida Ehlers 1908
Augener 1926, 1927B — NZ 36/174/?; 36/175/o; 37/176/t

Fabricia sp. — fide Banse 1957
as *Oithona sabella* Augener 1914 (partim) — WA 25/113/t
as *Fabricia sabella* (non Ehrenberg) Augener 1924A — Auckland Is.
50/166/i

- Hypsicomus phaeotaenia* (Schmarda 1861)
Augener 1914 — WA 25/113/t
- lost as *Sabella velata* Haswell 1884 — NSW 33/151/i
- Megalomma monophthalma* (Augener 1922A) — fide Hartman 1959
as *Sabella monophthalma* Augener 1922A — QLD 10/142/?
- Megalomma suspiciens* (Ehlers 1904) — fide Johansson 1927
- HZM as *Branchiomma suspiciens* Ehlers 1904 — NZ 41/172/t
Ehlers 1905, Benham 1909, Augener 1926 — NZ 34/174/i; 40/173/?;
43/172/i
- Myxicola infundibulum* (Renier 1804)
Knox and Cameron 1971, Poore et al., 1975 — VIC 38/144/i, t
- Oriopsis alata pectinata* Banse 1957
Knox and Cameron 1970 — NZ 48/166/i
as *Oridia limbata* (non Ehlers) — fide Banse 1957
Augener 1926 (partim) — Campbell Is. 52/169/i
- Oriopsis limbata* (Ehlers 1897) — fide Banse 1957
as *Oridia limbata* Augener 1926 (partim), Augener 1927A — VIC 38/149/o;
NZ 34/172/i; 35/174/i; 39/177/i
- Oriopsis michaelsoni* Banse 1957
as *Oithona sabella* Augener 1914 (partim) — WA 26/113/t
- Oriopsis parvula* (Ehlers 1913) — fide Banse 1957
as *Oridia parvula* Augener 1927A — NSW 33/151/i
- Oriopsis* sp. Banse 1957
as *Oridia limbata* Augener 1926 (partim) — NZ 39/177/?
- CM *Potamilla alba* Knox 1951B — NZ 40/173/d
- Potamilla armata* (Quatrefages 1865) — fide Johansson 1927
- ?MNHN as *Sabella armata* Quatrefages 1865 — New Zealand
- Potamilla oligophthalmus* Grube 1878
Augener 1914, 1926, 1927A — WA 25/113/t; NZ 37/174/i; 36/175/o;
39/173/t; 41/174/t
- HZM as *Potamilla laciniosa* Ehlers 1904, 1905, 1907 — NZ 43/172/?
- KM *Sabella aberrans* Augener 1926 — NZ 36/175/o
Benham 1927 — NZ 34/173/d
as *Sabella porifera* (non Grube) Augener 1914 (partim) — WA 25/113/t
- ?*Sabella fusca* Grube 1870
McIntosh 1885 — NSW 33/151/o
= *Sabellastarte indica* — fide Augener 1927A
- Sabella porifera* Grube 1878
Augener 1922A — QLD 10/142/?
- lost *Sabella punctulata* Haswell 1884 — NSW 33/151/i

Sabellastarte indica (Savigny 1818) Homonym

Augener 1914, 1927A, Johansson 1918, Rullier 1965, Knox and Cameron 1971 — WA 17/121/i; 19/113/t; 20/117/i; 20/118/i; 25/113/t; 32/115/t; VIC 38/144/t; NSW 33/151/i, t; QLD 27/153/i

as *Sabellastarte japonica* (Marenzeller 1884)

Benham 1916B — VIC 39/148/d

?AM

as *Spirographis australiensis* Haswell 1884 — NSW 33/151/i

Pope 1943 — NSW 33/151/i, t

Sabellastarte longa (Kinberg 1867)

Knox and Cameron 1971 — VIC 38/144/t

SERPULIDAE

Subfamily **Serpulinae**

BM *Apomatus elisabethae* McIntosh 1885 — NZ 41/174/t

BM *Apomatus lillei* Benham 1927 — NZ 34/173/d

AM *Crucigera inconstans* Straughan 1967A — NSW 33/151/i; 35/149/i; QLD 22/148/i; 24/151/i; 26/152/i; 28/153/i

AM *Ditrupa amphora* Dew 1959 — WA 23/113/d

Ditrupa australis Bretnell 1921 — QLD 16/146/o

Dew 1959 — NSW 33/151/t; 34/150/t; QLD 16/146/t

Ditrupa laeve (Brazier 1878)

Dew 1959 — WA 23/113/o

as *Ditrupa brazieri* Bretnell 1921 — fide Dew 1959

Bretnell 1921 — QLD 10/142/t, o; 12/143/t; 14/144/t

Ditrupa strangulata Deshayes 1855

Mörch 1863 — Australia

Eupomatus ralumianus (Augener 1927)

Poore et al., 1975 — VIC 38/144/t

Ficopomatus enigmaticus — fide ten Hove and Weerdenburg, 1978

as *Mercierella enigmatica* Fauvel 1923

Monro 1938, Dew 1959 (p.p.), Straughan 1966 (partim), 1967D — SA 35/138/e; VIC 38/140/e; NSW 29/153/e and estuaries to 34/150/e; QLD 19/146/e and estuaries to NSW border

Ficopomatus uschakovi — fide ten Hove and Weerdenburg, 1978

as *Mercierella uschakovi* (Pillai 1960)

as *Neopomatus uschakovi* Pillai 1971

as *Mercierella enigmatica* (non Fauvel) — fide Pillai 1971

Dew 1959 (partim), Straughan 1966 (partim) — NSW 30/151/e; 30/152/e; QLD 27/152/e

?MNHN

Galeolaria caespitosa Lamarck 1818 — Australia

Augener 1914, 1927, Pope 1943, Dew 1959, Straughan 1967A, Day

- 1975 — WA 32/115/i; 33/114/i; 34/115/i; 34/119/i; 34/122/i; 35/117/i; SA 34/137/i; 36/136/i; TAS 40/138/i; VIC 38/148/i; 38/144/i; 38/141/i; 39/147/i; NSW 29/153/i; 31/152/i; 32/151/i; 33/151/i; 34/150/i; 35/150/i; 37/149/i; QLD 25/152/i; 27/153/i; 28/153/i
- ?MNHN as *Vermilia bicarinata* Lamarck 1818 — Australia
- ?MNHN as *Galeolaria elongata* Lamarck 1818 — Australia
- as *Galeolaria decumbens* Sowerby 1820-25 in Mörch 1863 — Australia
- as *Serpula caespitosa* Grube 1850 — Australia
- KM as *Filigrana divaricata* Mörch 1863 — WA 35/117/i
- as *Galeolaria caespitosa* var. Mörch 1863 — Australia
- as *Vermilia caespitosa* Quatrefages 1865 — Australia
- ?MNHN as *Vermilia insidiosa* Quatrefages 1865 (partim) — Australia
- Galeolaria hystrix* (Mörch 1863)
- Ehlers 1907, Benham 1909, Fauvel 1917, Augener 1926, Allen and Wood 1950, Dew 1959, Straughan 1967A — SA 34/138/?; NSW 32/151/t; 33/151/t; 34/150/t; 35/150/t; 34/151/o; NZ 41/174/t; 43/172/o; 45/170/?
- KM as *Vermilia hystrix* Mörch 1863 — New Zealand
- BM as *Eupomatus boltoni* Baird 1865A — New Zealand
- ?MNHN as *Vermilia rosea* Quatrefages 1865 — Australia
- Haswell 1885 — NSW 33/151/i
- as *Galeolaria rosea* Ehlers 1904 — NZ 40/173/?
- Hydroides albiceps* (Grube 1869)
- Straughan 1967A — QLD 16/149/i; 22/150/i; 23/151/i; 27/153/i; 29/153/i
- Hydroides brachyacantha* Rioja 1941
- Dew 1959, Straughan 1967A — NSW 33/151/i; 34/150/i; 35/150/i; QLD 19/146/i; 22/149/i; 23/151/i; 24/152/i; 27/153/i; 28/153/i
- Hydroides dirampha* Mörch 1863 — fide ten Hove pers. comm.
- as *Hydroides (Eucarphus) cumingi* var. *navalis* Mörch 1863 — New Zealand
- as *Hydroides (Eucarphus) cumingi* Ehlers 1904, 1905 — New Zealand
- Hydroides elegans* (Haswell 1883)
- as *Hydroides norvegica* (non Gunnerus 1768) — fide Zibrowius 1971
- Dew 1958, 1959, Straughan 1967A — WA 32/115/?; SA 34/135?; VIC 38/144/?; NSW 32/151/i; 33/151/t; 35/150/?; 37/149/i; QLD 19/147/?; 23/152/?; 27/153/i, t
- lost as *Eupomatus elegans* Haswell 1883B — NSW 33/151/t
- as *Hydroides multispinosa* Marenzeller 1884 — fide Zibrowius 1972
- Augener 1914, 1927A, Allen and Wood 1950 — WA 25/113/t; 32/115/i; NSW 32/151/t; 33/151/i; 37/149/i; QLD 27/153/i

- AM as *Hydroides spinalateralis* Straughan 1967A — fide Zibrowius 1971 — QLD 22/151/i
- Hydroides exaltatus* Marenzeller 1884
Augener 1914, Dew 1959 — WA 25/113/t; QLD 19/146/?
- MNHN *Hydroides exaltatus vesiculosus* Fauvel 1919 — SA 35/136/?
- AM *Hydroides externispinosa* Straughan 1967B — QLD 23/151/i
- AM *Hydroides malleolaspina* Straughan 1967A — QLD 16/146/i; 21/150/i; 23/151/i; 24/152/i; 25/152/i
Straughan 1967B — QLD 23/151/i
- Hydroides monoceros* Gravier 1908
Straughan 1967A, 1967B — QLD 19/147/i; 23/151/i
- AM *Hydroides nodosa* Straughan 1967A — QLD 23/151/i
- Hydroides novaepommeraniae* Augener 1925
Dew 1958, 1959, Straughan 1967A — QLD 10/144/i; 19/146/i, t; 26/152/i
- Hydroides operculata* Treadwell 1919
- AM, QM as *Hydroides basispinosus* Straughan 1967A — fide Zibrowius 1971
Straughan 1967A — QLD 15/145/i; 16/146/i; 17/146/i; 19/151/i
- AM as *Hydroides gradata* Straughan 1967A — fide Zibrowius, pers. comm. — QLD 17/146/i
- MNHN *Hydroides perezii* Fauvel 1918
Straughan 1967A, 1967B — WA 25/113/?; QLD 19/147/i; 23/151/i
- AM *Hydroides recta* Straughan 1967A — QLD 16/146/i; 19/147/i; 22/149/i
- Hydroides tambalgamensis* Pillai 1961
Straughan 1967B — QLD 23/151/t
- Hydroides trivesiculosus* Straughan 1967B — QLD 23/151/i
- AM *Josephella marenzelleri* Caullery and Mesnil 1896
Dew 1958, 1959, Straughan 1967A, 1967B — NSW 33/151/t; 34/150/t; 35/150/i; QLD 23/151/i; 26/152/i
- Metavermilia acanthophora* (Augener 1914) — fide ten Hove 1975
- HZM as *Vermiliopsis acanthophora* Augener 1914 — WA 23/115/i
Dew 1959, Straughan 1967A, Knox and Cameron 1971 — VIC 38/144/t; NSW 32/152/i; 33/151/?; 34/150/?; QLD 27/153/d
- Neovermilia dewae* (Straughan 1967B) — fide ten Hove 1975
- AM as *Calcareopomatus dewae* Straughan 1967B — QLD 23/151/i
- Neovermilia globula* (Dew 1959) — fide ten Hove 1975
- AM as *Vermiliopsis globula* Dew 1959 — NSW 32/152/i; 33/151/i; 34/150/?i
Straughan 1967A (records repeated)
- Neovermilia sphaeropomatus* (Benham 1927) — fide ten Hove 1975

- BM as *Vermilia sphaeropomatus* Benham 1927 — NZ 34/172/d; 34/173/d
as *Vermiliopsis sphaeropomatus* Fyfe 1952 (record repeated)
- ?KM *Placostegus taeniatus serrulata* Mörch 1863 — Australia
Pomatoceros caeruleus (Schmarda 1861)
Ehlers 1907, Augener 1926, 1927B, Benham 1927, Day 1975 — WA 32/115/t; NZ 34/172/i; 35/174/i; 36/174/i; 37/175/i; 37/176/i, t; 39/173/t
- BM ?as *Vermetus cariniferus* Gray 1843 — New Zealand
?as *Placostegus cariniferus* Baird 1865A — NZ (repeat)
?as *Vermilia greyi* Quatrefages 1865 — NZ (repeat)
- ?ZUW as *Placostegus caeruleus* Schmarda 1861 — New Zealand
as *Vermilia caerulea* Quatrefages 1865 — NZ (repeat)
- ?KM *Pomatoceros strigiceps* Mörch 1863 — North Australia, New Zealand
Ehlers 1904, 1905 — ?NZ 40/173/?
Pomatoceros taeniatus (Lamarck 1818) — fide Zibrowius, pers. comm.
- ?MNHN as *Vermilia taeniata* Lamarck 1818 — Tasmania
- ?BM as *Pomatoceros terraenovae* Benham 1927 — type locality stated as South Trinidad in error but probably Australia — fide Zibrowius, pers. comm.
Dew 1959, Straughan 1967A, Knox and Cameron 1971, Poore et al., 1975 — SA 34/135/t; TAS 43/148/i; VIC 37/149/t; 38/148/t; 38/140/t; 38/144/t; 39/146/t; 39/148/?d; QLD 24/149/t; NZ 43/172/i
?as *Spirobranchus latiscapus* (non Marenzeller) — fide ten Hove 1970
Augener 1926 — VIC 38/148/d; 38/149/o, d
Pomatoceros sp. Augener 1924A — Auckland Is. 50/166/i, t
Pomatoleios kraussi (Baird 1864)
Dew 1959, Straughan 1967A, 1967C — QLD 15/145/i; 17/146/i; 18/146/i; 19/146/i; 20/148/i; 22/150/i; 23/151/i; 25/152/i; 27/153/i; NT 12/130/i
- Pomatostegus polytrema* (Philippi 1844) — see ? *Temporaria polytrema*
- Pomatostegus stellatus* (Abildgaard 1789)
Johansson 1918, Dew 1959, Straughan 1967A, 1967B, 1967C — WA 19/113/t; QLD 10/142/i; 16/146/i; 19/147/i; NT 12/130/i
as *Pomatostegus actinoceros* Mörch 1863
Augener 1914 — WA 25/113/?
- BM as *Pomatostegus bowerbankii* Baird 1865A — Australia
- ?MNHN *Serpula filaria* Lamarck 1818 — Australia — indeterminate — fide Hartman 1959
Serpula kaempferi (Kinberg 1866B)
as *Zopyrus kaempferi* Bush 1910 — Australia

- AM *Serpula lineatuba* Straughan 1967A — NSW 33/151/i
- AM *Serpula magna* Straughan 1967A, 1967C — QLD 19/146/i; 22/147/i; 23/153/i; NT 12/130/i
- BM *Serpula maorica* (Benham 1927)
as *Zopyrus maoricus* Benham 1927 — NZ 34/172/d
- AM *Serpula minuta* (Straughan 1967A) — fide ten Hove, pers. comm.
as *Pseudoserpula minuta* Straughan 1967A — QLD 16/150/i
- Serpula narconensis* Baird 1865
Collin 1902 — QLD 10/142/i
- AM, QM *Serpula rubens* Straughan 1967A — NSW 33/151/i; QLD 26/152/i; 28/153/i
- Serpula rugosa* (Straughan 1967A) — fide ten Hove, pers. comm.
- AM as *Pseudoserpula rugosa* Straughan 1967A — QLD 26/152/i
- Serpula vermicularis* Linnaeus 1767
Augener 1914, Dew 1959, Straughan 1967A, 1967B, Day 1975 — WA 25/113/t; 29/114/t; 32/115/t; 35/117/t; NSW 32/151/i; 33/151/i; 35/150/i; QLD 10/143/i; 16/146/i; 19/147/i; 23/151/i; 23/152/i; 27/153/i
- ?MNHN ?as *Serpula antarctica* Quatrefages 1865 — New Zealand
- BM as *Serpula jukesii* Baird 1865A — NSW 33/151/i
- lost as *Serpula vasifera* Haswell 1885 — NSW 33/151/?
- Serpula vermicularis* var. *granulosa* (Marenzeller 1885)
Johansson 1918 — WA 19/113/t
- HZM *Serpula vittata* Augener 1914 — WA 25/113/t
Straughan 1967B — QLD 23/151/t
- Serpula watsoni* Willey 1905
Straughan 1967A — N. Queensland
- BM *Serpula zealandica* Baird 1865A — New Zealand
as *Sclerostyla zealandica* Bush 1910 (record repeated)
- BM *Serpula* sp. A. Benham 1927 — NZ 34/173/d
- BM *Serpula* sp. B. Benham 1927 — NZ 34/172/d
- ?*Spirobranchus cariniferus* (Gray 1843)
(confused synonymy — see also under *Pomatoceros caeruleus*)
Ehlers 1907 — NZ 47/169/t
- ?MNHN ?as *Vermilia hombroni* Quatrefages 1865 — New Zealand
- ?MNHN ?as *Vermilia mahorica* Quatrefages 1865 — New Zealand
- Spirobranchus giganteus corniculata* (Grube 1862) — fide ten Hove 1970
as *Spirobranchus giganteus* (non Pallas)
Monro 1931, Dew 1959 (p.p.), Straughan 1967A, 1967B, 1967D — NSW 33/151/t (p.p.); 34/150/t (p.p.); QLD 10/142/t (p.p.); 16/145/i; 18/166/i, t; 23/150/t (p.p.); 23/151/i, t; 27/153/t (p.p.)

- MNHN ?as *Vermilia rostrata* Lamarck 1818 — Australia — fide Zibrowius, pers. comm.
- BM as *Cymospira brachycera* Baird 1865A — QLD 22/152/t
as *Cymospira tricornis* (non Mörch) Baird 1865A — QLD 22/151/t
- MNHN as *Cymospira moerchii* Quatrefages 1865 — Australia — fide ten Hove 1970
- MNHN ?as *Cymospira incompleta* Quatrefages 1865 — New Zealand — fide Zibrowius, pers. comm.
as *Spirobranchus gardineri* Pixell 1913 — fide ten Hove 1970
Straughan 1967A — QLD 23/151/t; 27/153/t
- Spirobranchus latiscapus* (Marenzeller 1885)
Benham 1916B, Augener 1926, Monro 1936, 1939, Knox 1951B, 1951C — TAS 41/148/d; VIC 39/148/d; NZ 34/173/d; 36/175/o; 40/173/d; 40/174/o, d
as *Pomatoceros strigiceps* (non Mörch) McIntosh 1885 — NZ 38/169/d — fide ten Hove 1970
- Spirobranchus tetraceros* (Schmarda 1861)
Johansson 1918 — WA 19/121/t
- ?ZUW as *Pomatoceros tetraceros* Schmarda 1861 — NSW (?locality)
as *Galeolaria tetraceros* Mörch 1863 (record repeated)
- ?KM as *Spirobranchus semperi* Mörch 1863 — fide ten Hove 1970
Augener 1913, 1914, Straughan 1967A — WA 25/113/t; QLD 22/150/i; 23/151/i; 24/152/i; 25/152/i
as *Spirobranchus tricornis* Mörch 1863 — fide ten Hove 1970
Straughan 1967A — NSW 29/153/i; 33/151/i; 34/150/i; 35/150/i; QLD 22/150/i; 24/152/i; 26/152/i; 27/153/i; 28/153/i
- lost as *Pomatoceros elephas* Haswell 1884 — NSW 33/151/? — fide ten Hove 1970
as *Spirobranchus giganteus* (non Pallas) — fide ten Hove 1970
Dew 1959 (p.p.) — NSW 33/151/t; 34/150/t; QLD 10/142/t; 23/150/t; 27/153/t
as *Spirobranchus coutierei* (Gravier 1908)
Straughan 1967C — NT 12/130/?
- AM ?as *Spirobranchus coronatus* Straughan 1967A, 1967B — QLD 23/151/i; 27/153/i — fide ten Hove 1970
- AM as *Spirobranchus corrugatus* Straughan 1967B — QLD 23/151/i — fide ten Hove 1970
- AM *Temporaria oligotrema* Straughan 1967A, 1967B — QLD 16/145/i; 16/146/i; 22/149/i; 23/151/i; 24/152/i; 25/152/i; 26/152/i; 27/153/i, t
as *Temporaria monotrema* Straughan 1967A (in error) — QLD 23/151/i

?*Temporaria polytrema* (Philippi 1844) — species inquirenda
 Straughan 1967A, Knox and Cameron 1971 — VIC 38/144 (tube only);
 NSW 33/151/i; 34/150/i; 35/150/i

as *Vermilia polytrema* Philippi 1844 — type material mixed; not
Pomatostegus but either *Vermiliopsis* or *Pomatoceros* — fide ten
 Hove pers. comm.

Vermiliopsis glandigera Gravier 1908
 Monro 1939 — TAS 42/148/d

Vermiliopsis infundibulum (Linnaeus 1788)
 Straughan 1967A, 1967B, Knox and Cameron 1971 — VIC 38/145/?;
 NSW 32/152/i; QLD 19/147/i; 22/150/i; 23/151/i; 25/152/i; 27/153/i

AM *Vermiliopsis minuta* Straughan 1967B — QLD 23/151/i; — indeterminate —
 fide ten Hove 1975

Vermiliopsis pygidialis (Willey 1905) — part of the *Vermiliopsis infundibulum*,
V. glandigerus complex — fide ten Hove pers. comm.
 Dew 1958, Straughan 1967A, 1967B, 1967C, — NSW 33/151/in
 aquarium; QLD 23/151/i; 25/152/i; NT 12/130/i

BM *Vermilia producta* Benham 1927 — NZ 34/173/d — species inquirenda — fide
 ten Hove pers. comm.

Subfamily Filograninae

Filograna implexa Berkeley 1828
 Benham 1927, Knox 1951B — NZ 34/172/d; 34/173/t, d; 40/173/d

as *Salmacina dysteri* (Huxley 1885) — fide McIntosh 1923, Day 1965
 Augener 1914, Fauvel 1917, Monro 1931, Dew 1959, Straughan 1967A,
 1967B, Knox and Cameron 1971 — WA 25/113/?; 32/115/i; 35/117/t;
 35/118/?; SA 34/137/?; 34/138/?; 35/138/t; 35/139/?; VIC 38/141/?;
 38/144/t; 38/148/t; NSW 28/153/i; 29/153/?; 31/152/i; 32/152/i; 33/151/i;
 34/150/t; 35/150/t; 36/150/?; 37/149/t; QLD 9/143/i; 10/142/t; 18/146/i;
 22/150/i; 23/151/i; 23/152/?; 24/151/i; 27/153/t

lost as *Salmacina australis* Haswell 1884 — NSW 33/151/?
 Augener 1924A, 1926, 1927A, 1927B, Pope 1943 — VIC 38/149/d; NSW
 33/151/i, t; 37/149/o; 37/150/o, d; NZ 34/172/o; 36/174/t; 36/175/o;
 37/176/t; Auckland Is. 50/166/i

as *Salmacina dysteri* var. *australis* Benham 1916B — WA 35/118/o; TAS
 41/148/d; 42/148/d

Protula bispiralis (Savigny 1820)
 Ehlers 1907, Fauvel 1922, Augener 1926, Benham 1900, 1927 — WA
 28/113/i; NZ 34/172/d; 44/171/?; 46/168/?; 47/168/?

AM ?as *Protula magnifica* Straughan 1967B — QLD 23/151/i

?as *Protula* sp. Benham 1900 — NZ 44/171/o

Protula tubularia (Montagu 1803)
 as *Protula palliata* Willey 1905 — fide Pillai 1971

Augener 1914, Dew 1959, Straughan 1967A, 1967B — WA 25/113/i;
32/115/i; NSW 33/151/i; 34/150/i; QLD 18/146/i; 23/151/i; 25/152/i;
26/152/i; 27/153/i

as *Protulopsis palliata* Benham 1916B — TAS 42/148/d

Subfamily **Spirorbinae**

Amplaria spiculosa Knight— Jones 1973 — SA 35/137/i
Knight—Jones et al., 1974 — record repeated
Vine 1977 — NZ 35/174/t

Eulaeospira convexis (Wisely 1963) — fide Knight-Jones 1973

AM, BM as *Spirorbis convexis* Wisely 1962 — NSW 34/151/t

Janua (Dexiospira) brasiliensis (Grube 1872)
Knight-Jones et al., 1975A — NSW 33/151/i

as *Janua (D.) pseudocorrugata* (non Bush) Vine 1977 — NZ 36/174/t — fide
Knight-Jones, pers. comm.

as *Janua (D.) foraminosa* (Bush 1904) Knight-Jones 1973 — NSW 33/151/i

Janua (Dexiospira) formosa var. *australis* Knight-Jones et al., 1974 — NSW
33/151/i

as *Janua (D.) formosa* (Bush 1904) Knight-Jones 1973 — NSW

Janua (Dexiospira) lamellosa (Lamarck 1818)
Knight — Jones et al., 1974 — SA 35/118/t

MNHN as *Spirorbis lamellosus* Lamarck 1818 — WA 35/117/?
Mörch 1863, Wisely 1962 — WA 35/117/?; NSW 34/151/t

Janua (Dexiospira) pseudocorrugata (Bush 1904)
Knight-Jones 1973, Knight-Jones et al., 1974, Vine 1977 — SA 35/137/i;
NSW 33/151/i; NZ 35/174/i; 43/172/i

Janua (D.) pseudocorrugata var. *fenestrata* Knight-Jones 1973

AM, BM as *Janua (D.) fenestrata* Knight-Jones 1973, Knight-Jones et al., 1974 — SA
36/136/i, t

Janua (Dexiospira) steueri (Sterzinger 1909)
Knight-Jones 1973, Knight-Jones et al., 1974, Vine 1977 — SA 35/137/i;
NZ 42/173/i

as *Spirorbis (Dexiospira) treadwelli* Pillai 1965 — fide Knight-Jones et al.,
1975A
Straughan 1967B — QLD 25/151/i

Janua (Janua) pagenstecheri (Quatrefages 1865)
Knight-Jones 1973, Knight-Jones et al., 1974, Vine 1977 — SA 36/136/i;
NZ 35/174/o

AM, BM *Janua (Pillaiospira) trifurcata* Knight-Jones 1973 — SA 35/138/t
Knight-Jones et al., 1974 (record repeated)

Metalaeospira clansmani Vine 1977 — NZ 35/174/t

- Metalaeospira incisus* (Mörch 1863) — fide Knight-Jones, pers. comm.
as *Spirorbis* (?*Spirillum*) *incisus* Mörch 1863 — WA 35/117/i
- Metalaeospira pixelli* (Harris 1969) — fide Vine 1977
as *Spirorbis* (*Paralaeospira*) *antarcticus* Pixell 1913 — Homonym
Knox and Cameron 1971 — VIC 38/144/t
- BM, AM *Metalaeospira tenuis* Knight-Jones 1973 — SA 35/138/t; 36/136/i
Knight-Jones et al., 1974 — records repeated
- Paralaeospira levinseni* (Caullery and Mesnil 1897)
Vine 1977 — NZ 35/174/i, t; 36/174/i; 42/173/i
as *Spirorbis nordenskjoldi* Ehlers 1900 — fide Knight-Jones, pers. comm.
Augener 1926 — NZ 34/172/i; 36/174/i; 47/169/i
as *Pileolaria nordenskjoldi* Vine 1977 — records repeated
- Paralaeospira monacanthus* (Augener 1924) — fide Vine 1977
- HZM as *Spirorbis monacanthus* Augener 1924A — Auckland Is. 50/166/i
Augener 1926 — NZ 36/174/i; 47/168/i
- Paralaeospira patagonicus* Caullery and Mesnil
Poore et al., 1975 — VIC 38/144/t
- Pileolaria* (*Duplicaria*) *koehleri* (Caullery and Mesnil 1897)
Knight-Jones et al., 1974, Vine 1977 — QLD (Gt. Barrier Reef); NZ 35/174/t
- Pileolaria* (*Duplicaria*) *pocillator* Vine 1977 — NZ 36/174/i
- Pileolaria* (*Pileolaria*) *militaris* (Claparède 1888)
Knight-Jones 1973, Knight-Jones et al., 1974 — SA 35/137/i; NSW 33/151/i
- Pileolaria* (*Pileolaria*) *tegwyni* Vine 1977 — QLD (?locality); NZ 35/174/o
- Pileolaria* (*Simplicaria*) *ovata* Vine 1977 — NZ 36/174/t
- Pileolaria* (*Simplicaria*) *pseudomilitaris* (Thiriot -Quièvreux)
Knight-Jones 1973, Knight-Jones et al., 1974, Vine 1977 — SA 35/137/i; NSW 33/151/i; NZ 36/174/i
- Protalaeospira ambilateralis* (Pixell 1913)
Vine 1977 — NZ 32/175/d (480 km north of Auckland)
- Protalaeospira augeneri* Vine 1977 — NZ 35/174/t
as *Spirorbis nordenskjoldi* (non Ehlers) Augener 1924A, 1924B — Auckland Is. 50/166/i
- AM, BM *Protalaeospira canina* Knight-Jones 1973 — SA 35/138/t
- Protalaeospira capensis* (Day 1961)
Vine 1977 — NZ 36/175/t
as *Protalaeospira translucens* Bailey 1963 — fide Knight-Jones, pers. comm. — Vine 1977 — NZ 35/175/d
- Protalaeospira gracei* Vine 1977 — NZ 35/174/o

- Protolaeospira lebruni* (Caullery and Mesnil 1897)
Vine 1977 — NZ 36/174/t
- Protolaeospira tricostalis* (Lamarck 1818) — fide Knight-Jones pers. comm.
?KM as *Spirorbis tricostalis* Mörch 1863 — WA 35/117/?i
- AM, BM *Protolaeospira triflabellis* Knight-Jones 1973, Knight-Jones et al., 1974 — SA 35/138/t; 36/136/i, t
- Romanchella perrieri* (Caullery and Mesnil 1897) — fide Knight-Jones 1975A
Vine 1977 — NZ 35/174/t, o
as *Spirorbis perrieri* Ehlers 1907 — NZ 45/170/?
- Romanchella* (*Romanchella*) *quadricostalis* Knight-Jones 1973
Knight-Jones et al., 1974 — SA 36/136/i
- Romanchella solea* Vine 1977 — NZ 35/174/o
- Spirorbis* (*Spirorbis*) *bidentatus* Bailey 1968
Vine 1977 — NZ 35/174/o
- Spirorbis inversus* Bush 1910 — VIC 38/144/i
- Spirorbis tridentatus* Bush 1910 — Homonym — VIC 38/144/i
- BM *Spirorbis zelandica* Gray 1843 — indeterminate — fide Vine 1977
Mörch 1863, Augener 1926 — NZ 36/175/?; 43/172/?
?= *Paralaeospira levinseni* fide Knight-Jones, per. comm.
- BM *Spirorbis* sp. A. Benham 1927 — NZ 34/172/d
- Spirorbis* (*Paralaeospira*) sp. Knox and Cameron 1971 — VIC 38/144/t

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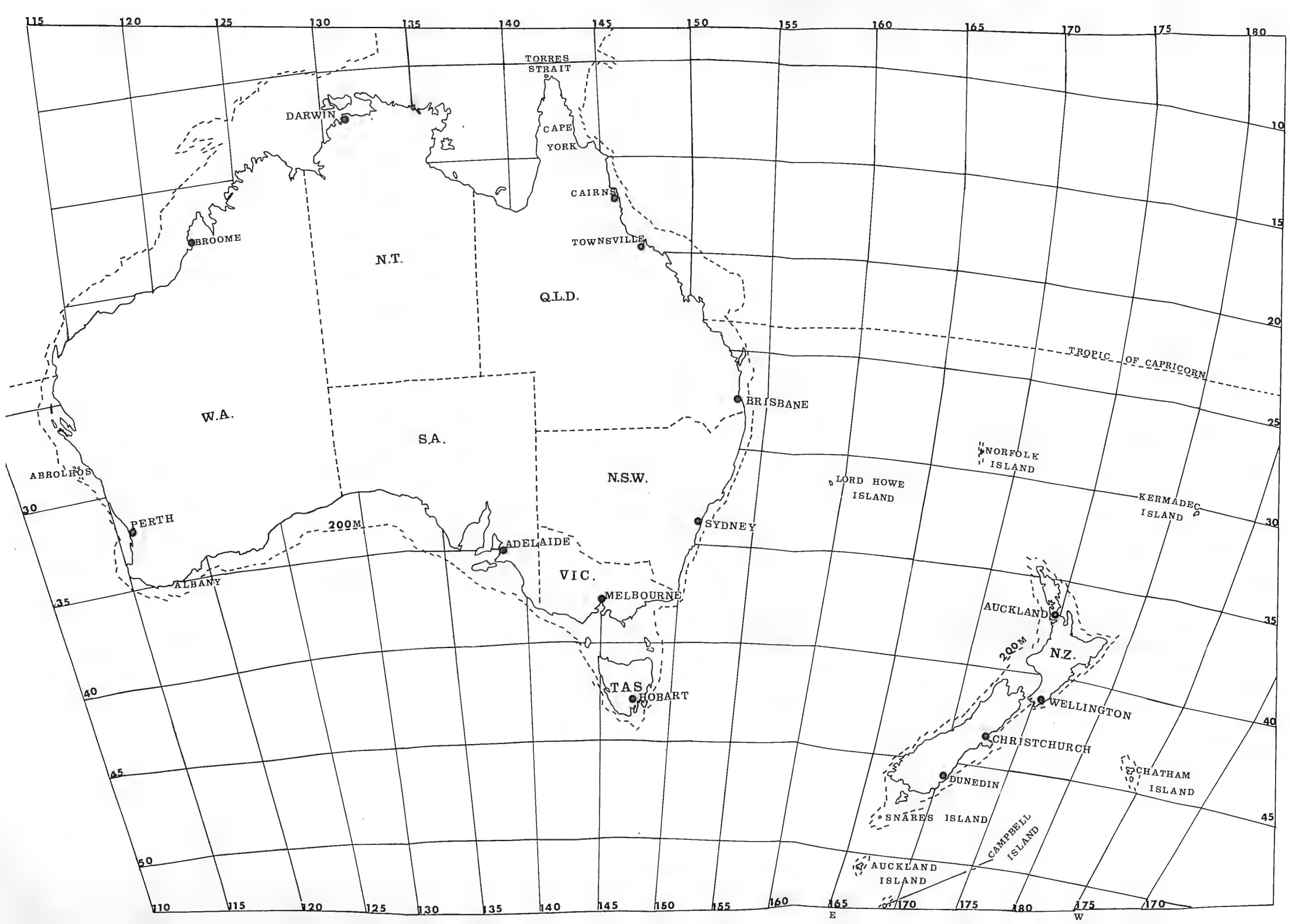
Footnote:

While this paper was in press, the following paper appeared.

Blake, J. A. and Kudenov, J. D. 1978. The Spionidae (Polychaeta) from south eastern Australia and adjacent areas with a revision of the genera. *Mem. Nat. Mus. Vict.* 39: 171-280.

In Banse, K 1977. A new subfamily Notophycinae (Polychaeta: Nereidae) for *Micronereis* Claparède and *Quadricirra* new genus. Essays on Polychaetous annelids in Memory of Dr Olga Hartman, K. Fauchald and D. Reish, eds., Allan Hancock Foundation, Los Angeles, the taxonomic position of *Micronereis halei* and *Notophycus minutus* is changed.

The recommendation by Lucas and Holthius that the genus *Pectinaria* become a synonym of *Cistena* has been challenged and seems unlikely to be accepted by the International Commission.



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RECORDS OF THE AUSTRALIAN MUSEUM

TYPE SPECIMENS OF REPTILES AND AMPHIBIANS

H. G. COGGER

SCLERACTINIAN CORAL *ARCHOHELIA* OF QUEENSLAND

JOHN W. WELLS AND PHILIP N. ALDERSLADE

THALASSINIDEA (CRUSTACEA: DECAPODA) OF AUSTRALIA

GARY C. B. POORE AND D. J. G. GRIFFIN



TYPE SPECIMENS OF REPTILES AND AMPHIBIANS IN THE AUSTRALIAN MUSEUM

H. G. COGGER



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TYPE SPECIMENS OF REPTILES AND AMPHIBIANS IN THE AUSTRALIAN MUSEUM

H. G. COGGER

INTRODUCTION

The following catalogue lists, for the first time, the primary and supplementary type specimens of amphibians and reptiles in The Australian Museum. It seems desirable to record, from time to time in a museum's history, the status of type collections on which a great deal of taxonomic research is ultimately based.

The past century has seen many changes in taxonomic and curatorial approaches to type material, and many recent studies have been hampered by the failure of some earlier workers to designate clearly, type specimens and/or their depository. Literature references to type material often fail to correspond with designated specimens or catalogued data in museums, and a museum curator is often faced with problems of correlating published descriptions with specimens or catalogues in his charge.

The Australian Museum, which was founded in 1827, is the oldest natural history museum in Australia. It moved to its present site in 1848 (the first building is now the north-west wing of the present building), but relatively little is known of the early history of its collections. Initially most specimens were acquired solely for display value as 'natural curiosities'; not until the 1860's was the nucleus of a research and reference collection established.

At the time of writing, these collections consist of approximately 75,000 specimens, almost all of which are from Australia and the south-west Pacific region. There are 969 primary and 2 supplementary type specimens (as defined by Mayr *et al.*, 1953, p. 239) in these collections, including the recently acquired type collection of the Macleay Museum in the University of Sydney.

HISTORY OF THE HERPETOLOGICAL COLLECTIONS

Little is known of the herpetological collections prior to the time of Gerard Krefft, (1830-1881) who was Curator (=Director) of the Museum from 1860 until 1874. Probably the first published reference to these collections is that of Bennett (1834) who commented that "I visited the colonial museum, which is arranged for the present in a small room There are also several of the mammalia, and reptiles of the colony in the collection . . ." Bennett subsequently became Curator of the Museum, and although he had a limited interest in herpetology (Bennett, 1837; Coppleson, 1955) he was not noticeably active in this field. Gerard Krefft, after his appointment in 1860, actively acquired reptiles for the Museum and wrote numerous papers on reptiles (Whitley, 1969). However, Krefft had a lengthy and bitter dispute with the Museum's Trustees (Whitley, 1969) which may well have affected the state of the herpetological collections. Also, much of the material acquired by Krefft was lodged in European museums. Nevertheless, the collections apparently flourished under Krefft's interest, for in the *Sydney Morning Herald* of May 13, 1864 (p.2), in a leading article on The Australian Museum, it was said that "The reptile case with its now almost dormant inmates, appears to be a great attraction to the visitors, numbers of whom

are constantly gathered round it. Amongst the harmless snakes in the case are five specimens of the diamond snake, one of the carpet snake, and one of the green-tree snake. The venomous species consist of two death adders, a black snake, and a brown banded snake. The lizards in the case are a lace lizard (the so-called Iguana), the Bearded Grammatophora, and the Giant Cyclodus . . . at present the collections contain above 1200 specimens; all of them are named . . .".

By 1866, it was stated in Leigh and Co's Handbook to Sydney and Suburbs (published in 1867) that ". . . the collection of snakes, lizards, and frogs is exceedingly large; it contains nearly 300 genera, 500 species, and upwards of 2000 specimens."

The first department of reptiles and amphibians (administered jointly with fishes) appears to have come into being under E. P. Ramsay's directorship in 1885 and was under the charge of James Douglas Ogilby (Whitley, 1929) until he left the Museum in 1890. Prior to this, reptiles and amphibians would have been the personal responsibility of the Director.

From 1890 to 1893 the Department of Reptiles, Amphibians and Fishes was run by Thomas Whitelegge, an invertebrate zoologist whose work has been documented by McNeill and Whitley (1929). Whitelegge was succeeded in 1893 by Edgar R. Waite, who ran the department until he resigned in March 1906. Waite, who was also in charge of mammals and skeletons, published numerous herpetological papers (Hale, 1928).

As 1893 was a year of acute financial depression, some of the staff of The Australian Museum were retrenched and for a number of years there were several unpaid assistants in various departments. One of these in the late 1890's was Allen R. McCulloch, who was appointed "Zoologist" on Waite's retirement in 1906. He was probably responsible for the herpetological collections from 1906 until 1918, when he was formally placed in charge of these collections. Although McCulloch was primarily interested in fishes and crustaceans, he published several papers in herpetology (Anderson and Whitley, 1929).

Dene Barrett Fry, born in 1894, was appointed a Scientific Cadet, probably in 1908, and was McCulloch's assistant. There is no record that he was in charge of the herpetology department, although there is little doubt that in practice he was responsible for the curating of the herpetological collections. Fry published the results of his researches in a number of scientific papers. He developed a card-file bibliography of Australian herpetology and made many valuable notes (unpublished) on material at that time in the Macleay Museum: Fry was killed in action in the Great War, in 1917.

James Roy Kinghorn, who joined the staff in 1907 as a Scientific Cadet, was assistant to McCulloch (in the field of carcinology) until he left for the war in 1915. Subsequently, upon his return from the war in 1918, Kinghorn was given charge first of reptiles, and later of the joint departments of birds and reptiles and amphibians. The latter two groups were separated from the Department of Fishes which was then left under McCulloch's curatorship.

Kinghorn, who published numerous herpetological papers, subsequently became Curator of Birds, Reptiles and Amphibians, which position he held until his retirement in 1956. At the time of his retirement, he was also Assistant Director.

J. Allen Keast was made a trainee in Kinghorn's Department in 1947, and after studies at the University of Sydney (and later at Harvard University) was appointed Assistant Curator of Birds, Reptiles and Amphibians in 1955 and became Curator in 1957. Keast left The

Australian Museum on leave in 1959 and after resigning in 1961 was succeeded by the author. Having joined the Museum staff in 1952 as a Cadet Preparator, the author later (1955) obtained a traineeship to the University of Sydney and upon returning to the Museum in 1959 was appointed Assistant Curator of Birds, Reptiles and Amphibians. In 1961 the Department of Ornithology was separated from the Department of Herpetology, and in 1962 H. J. de S. Disney was appointed Curator of Birds. The author took charge of the Department of Herpetology and was appointed Curator of Reptiles and Amphibians in 1962 and in 1976 was also appointed to the Deputy Directorship. Allen E. Greer was appointed to a second curatorship in herpetology in July, 1977.

In the following list of types, each form appears in alphabetical order within its appropriate order, suborder or family. Each name is cited as it appears in the original description. In addition to the original reference, type description, catalogue number(s) and the type locality, there may be an additional entry under "Remarks." Under this heading are included any comments regarding inconsistencies between the original descriptions and the specimens, their labels or register entries, or comments that might otherwise assist future workers in identifying material cited by the describers of particular species.

Finally, where appropriate, is given the combination under which the species is currently known or the name of the species of which it is currently regarded as a synonym.

The first formal register (known as the 'Palmer' register after its principal compiler) was established in 1877. This register, like its immediate successors, included all groups of animals between one set of covers; specimens were numbered in a continuous series, without any identifying prefix. The Palmer register was followed by two further registers, known as 'A' and 'B' registers because they each repeated the same numerical series but provided an identifying A or B prefix to the catalogue number. Not until 1886 were the first departmental registers established, whereby the catalogue numbers for each major group of organisms were given a unique prefix of one or more letters of the alphabet. Since that time the catalogue numbers of all reptiles and amphibians carry the prefix R. Thus the prefix letter is an integral part of the catalogue number and should never be omitted when citing Australian Museum specimens, for to do so, could confuse these specimens with ones carrying other prefix letters or with ones registered prior to 1871, with no prefix.

In 1969 The Australian Museum was given, on permanent loan, the collection of primary herpetological type specimens in the Macleay Museum, University of Sydney. This collection was transferred from the Macleay Museum after a complete list of specimens had been prepared; the list was published only a few months later (Goldman *et al.*, 1969). These specimens have since been catalogued under Australian Museum numbers, but their original Macleay Museum numbers are also cited in parentheses with the Macleay Museum (MM) prefix.

Two specimens of *Peripia ornata* (MM MR 915, MR 916) were cited by Goldman *et al.*, (1969) as type specimens, but their type status has been rejected by Kluge (1963).

Finally, I am grateful to the late Gilbert P. Whitley and to my predecessor, Mr. J. R. Kinghorn, for their help in compiling a brief history of the herpetological collections.

For their assistance I am also grateful to Mrs. R. D. Brewer, Mr. P. Webber, Mrs. A. Young, Mr. H. Ehmann and Miss E. Cameron.

LIST OF PRIMARY AND SUPPLEMENTARY TYPE SPECIMENS
IN THE AUSTRALIAN MUSEUM

Class Amphibia

Order Salientia

Family **Myobatrachidae***Crinia froggatti* Fletcher1891 (1892), *Proc. Linn. Soc. N.S.W.*, (2) 6:275.

SYNTYPES (10): R8338, R10326, R49776-49783, Ballarat, Victoria (J. J. Fletcher).

= *Geocrinia victoriana**Crinia glauerti* Loveridge1933, *Occ. Pap. Boston Soc. nat. Hist.*, 8:57.

PARATYPE: R10910, Mundaring near Perth, Western Australia (P. J. Darlington, 22 November 1931).

= *Ranidella glauerti**Crinia haswelli* Fletcher1894, *Proc. Linn. Soc. N.S.W.*, (2) 8:522.

SYNTYPES (4): R10335, R49816-49818, Jervis Bay, New South Wales (J. J. Fletcher).

= *Paracrinia haswelli*

Remarks: The original description cites five specimens in the type series; one syntype is therefore presumed missing.

Crinia insignifera Moore1954, *Am. Nat.*, 88:71.

HOLOTYPE: R16007, Attadale, Western Australia (according to label attached to specimen; original description cites Armadale, Western Australia).

= *Ranidella insignifera**Crinia leai* Fletcher1898, *Proc. Linn. Soc. N.S.W.*, 22:667.

SYNTYPES (8): R8337, R49819-49821, Bridgetown, Western Australia (A.M. Lea); R10324, R49822-49824, Pipe Clay Creek, Western Australia (E. P. Richards).

= *Geocrinia leai*

Remarks: Syntype data derived from register and old labels accompanying specimens. However, the numbers of specimens from each locality do not coincide with the

numbers cited in the original description, and there would seem to be no way to correlate the individual specimens with the localities cited in the original description.

Crinia riparia Littlejohn and Martin

1965, *Copeia*, 1965 (3): 319, figs. 1-5.

HOLOTYPE: R26161, Alligator Gorge, 8.5 miles SSW Wilmington, South Australia (M. J. Littlejohn and A. A. Martin).

PARATYPES (3): R26162-26164, data as for holotype.

= *Australocrinia riparia*

Crinia signifera englishi Parker

1940, *Novit. zool.*, 42(1):89.

SYNTYPES (16): R6041-6045, R49825, R49826, Launceston, Tasmania; R7601 (2), Ulverstone, Tasmania (J. J. Fletcher); R10353, Eagle Hawk Neck, Tasmania (F. N. Blanchard); R10356, R10357, R49827-49830, National Park, Tasmania (F. N. Blanchard).

= *Ranidella signifera*

Remarks: The two specimens catalogued under R7601 not located, while each of the original register entries for R10356 and R10357 cite one more specimen than is present.

Crinia signifera montana Parker

1940, *Novit. zool.*, 42(1):90.

SYNTYPES (32): R579, Mt. Kosciusko, 5,500 ft, New South Wales (R. Helms); R4647, R54676, Mt. Kosciusko, 5,000ft, New South Wales (C. Hedley); R5044, R5046-5048, R5050-5053, R54677-54679, Mt. Kosciusko, 7,000ft, New South Wales (T. H. Johnstone); R7439, R54680-54690, Pretty Point, Mt. Kosciusko, New South Wales (J. J. Fletcher); R9741, R9743, R54691, R54692, Lake Cootapatamba, Mt. Kosciusko, 6,500ft, New South Wales (A. Musgrave and H. O. Fletcher); R9742 (2), Rawson Pass, Mt. Kosciusko, 6,800ft, New South Wales (A. Musgrave and H. O. Fletcher).

= *Ranidella signifera*

Remarks: The two specimens catalogued under R9742 cannot be located. Main (in litt.) has indicated that R5044 and R4677 are not conspecific with the other syntypes, but that they are otherwise indeterminate.

Crinia sloanei Littlejohn

1958, *Proc. Linn. Soc. N.S.W.*, 83(2): 225.

HOLOTYPE: R19610, Tocumwal, on Murray River, New South Wales (M. J. and P. G. Littlejohn, 6 August 1957).

ALLOTYPE: R19611, data as for holotype.

PARATYPES (2): R19612, R19613, data as for holotype.

= *Ranidella sloanei*

Crinia tinnula Straughan and Main

1966, *Proc. R. Soc. Qd*, 78(2):19, pl. 1, fig. 1, pl. 3, fig. 1, pl. 6B.

PARATYPES (6): R25931-25936, Rose Creek, Beerburrum, Queensland (A. R. and I. R. Straughan, 3 August 1965).

= *Ranidella tinnula*

Cyclorana slevini Loveridge

1950, *Proc. biol. Soc. Wash.*, 63:131.

PARATYPE: R13816, Noondoo, south-eastern Queensland, near the Queensland-New South Wales border (J. R. Slevin, 17 September 1947).

= *Cyclorana platycephalus*

Heleioporus sudelli Lamb

1911, *Ann. Qd Mus.*, 10:26.

PARATYPE: R5511, Warwick, Queensland.

= *Neobatrachus pictus*

Kyarranus kundagungan Ingram and Corben

1975, *Mem. Qd Mus.*, 17(2):335, pl. 42.

PARATYPES (2): R38193, R38194, south of Cunningham's Gap, in 28°06'S, 152°25'E, Queensland (C. Corben and G. Ingram, 1 December 1972).

Kyarranus sphagnicolus Moore

1958, *Am. Mus. Novit.*, 1919:4, fig. 2.

HOLOTYPE: R16005, Point Lookout, New South Wales (J. R. Moore, 21 November 1952).

Limnodynastes dorsalis interioris Fry

1913, *Rec. Aust. Mus.*, 10(2):33, pl. 3, fig. 1.

HOLOTYPE: R5869, Merool Creek, Riverina, New South Wales (James Ramsay).

PARATYPES (3): R975, R976, Yandenbah, Riverina, New South Wales (K. H. Bennett); R5870, no data.

= *Limnodynastes interioris*

Limnodynastes dorsalis terraereginae Fry

1915, *Proc. R. Soc. Qd*, 27(4):67, fig. 2a.

HOLOTYPE: R4525, Somerset, Cape York, Queensland (C. Hedley and A. R. McCulloch).

PARATYPE: R4526, data as for holotype.

= *Limnodynastes terraereginae*

Limnodynastes dumerili fryi Martin

1972, *Aust. J. Zool.*, 20:182.

HOLOTYPE: R32747, 9.6 km NE of Thredbo Village, Snowy Mountains, about 1370 m, New South Wales (A. A. Martin, 5 December 1965).

Limnodynastes dumerili variegatus Martin

1972, *Aust. J. Zool.*, 20:181, fig. 7B.

HOLOTYPE: R32742, 6.4 km N of Cape Otway, Victoria (A. A. Martin and P. A. Rawlinson, 8 December 1966).

PARATYPES (4): R32743-32746, data as for holotype.

Limnodynastes marmoratus Lamb

1911, *Ann. Qd Mus.*, 10:28.

PARATYPE: R5509, Goondiwindi, Queensland.

= *Limnodynastes fletcheri*

Remarks: Lamb, in the original description, does not cite any specimen other than "type" in the Queensland Museum from Goondiwindi, but Fry (1915) refers to the above "co-type" in The Australian Museum, while Covacevich (1971) regarded a series of specimens in the Queensland Museum (from which the above specimen is derived) as type specimens.

Mixophyes balbus Straughan

1968, *Proc. Linn. Soc. N.S.W.*, 93(1):55, pl. 2, fig. 1.

HOLOTYPE: R25922, Point Lookout, New England National Park, New South Wales (I. R. Straughan, 15 October 1963).

PARATYPES (6): R25923-25928, data as for holotype.

Mixophyes fasciolatus schevilli Loveridge

1933, *Occ. Pap. Boston Soc. nat. Hist.*, 8:55.

PARATYPE: R10909, Millaa Millaa, Atherton Tableland, Queensland (P. J. Darlington, 1-9 April 1932).

= *Mixophyes schevilli*

Mixophyes iteratus Straughan

1968, *Proc. Linn. Soc. N.S.W.*, 93(1):54, pl. 1, fig 2.

HOLOTYPE: R25929, Tweed River, Mount Warning National Park, New South Wales (I. R. Straughan, 23 December 1963).

PARATYPE: R25930, data as for holotype.

Phanerotis fletcheri Boulenger

1890 (1891), *Proc. Linn. Soc. N.S.W.*, (2)5(3):594.

= *Lechriodus fletcheri*

Remarks: Specimens R8330 and R29955 (MM R57) from Dunoon, Richmond River, New South Wales, are listed as "co-types", but reference to the original description would indicate that although these specimens came from the same source as the holotype, they were not in fact seen by Boulenger and therefore do not appear to qualify for type status.

Phanerotis novae-guineae Van Kampen

1909, *Novae Guinea, Zool.*, 9(1):36.

SYNTYPE: R6693, Merauke, West Irian.

= *Limnodynastes convexiusculus*

Philocryphus flavoguttatus Fletcher

1894, *Proc. Linn. Soc. N.S.W.*, (2)8:233.

LECTOTYPE: R29953 (MM R49), Mt. Victoria, Blue Mountains, New South Wales (*vide* Goldman, Hill and Stanbury, 1969).

ALLOTYPE: R29954 (MM R50), Thornleigh, Sydney, New South Wales (*vide* Goldman, Hill and Stanbury, 1969).

= *Heleioporus australiacus*

Pseudophryne brooksi Loveridge

1933, *Occ. Pap. Boston Soc. nat. Hist.*, 8:59.

PARATYPE: R10911, Western Australia (W. S. Brooks, 7 February 1927).

= *Pseudophryne guentheri*

Remarks: The original description cites Manjimup, near Pemberton, Western Australia, as the locality for this specimen.

Pseudophryne corroboree Moore

1953, *Proc. Linn. Soc. N.S.W.*, 78(3/4):179, figs.

HOLOTYPE: R13103, Round Mountain, New South Wales (O. Rixon, *vide* Colefax, 1956). Originally recorded from Towong Hill Station, Corryong, Victoria.

Rheobatrachus silus Liem

1973, *Mem. Qd Mus.*, 16(3):467.

PARATYPE: R32876, Kondalilla, 3 km SW Montville, south-eastern Queensland (D. S. Liem, 30 June 1972).

Taudactylus diurnis Straughan and Lee

1966, *Proc. R. Soc. Qd*, 77(6):63, figs. 1-2.

PARATYPES (6): R24656-24661, Green's Falls, Maiala National Park, Mt. Glorious, Queensland (I. R. Straughan, 12 May 1965).

Taudactylus eungellensis Liem and Hosmer

1973, *Mem. Qd Mus.*, 16(3):445, figs. 1C, 2D, 3D, 8.

PARATYPES (2): R32736-32737, Finch Hatton Gorge, 60 km W Mackay, central-eastern Queensland (D. S. Liem, 19 May 1972).

Taudactylus rheophilus Liem and Hosmer

1973, *Mem. Qd Mus.*, 16(3):450, figs. 1A, 2A, 2C, 2E, 3A, 3E, 4C, 5, pl. 29.

PARATYPES (2): R32738-32739, Mt. Lewis, 100 km NW Cairns, northern Queensland (D. S. Liem and W. Hosmer, 27 May 1972).

Family **Hylidae**

Hyla aurea ulongae Loveridge

1950, *Proc. biol. Soc. Wash.*, 63:133.

HOLOTYPE: R13817, Ulong, New South Wales (J. R. Slevin, 28 January 1948).

= *Litoria aurea*

Hyla bicolor glauerti Copland

1957, *Proc. Linn. Soc. N.S.W.*, 82(1):16.

HOLOTYPE: R18585, Colo, near Sydney, New South Wales (S. J. Copland, 18 September 1938).

= *Litoria fallax*

Hyla booroolongensis Moore

1961, *Bull. Am. Mus. nat. Hist.*, 121(3): 292, figs. 59, 60, pl. 45, fig. 1.

HOLOTYPE: R16006, Guy Fawkes Creek, 4,200 ft, Ebor, New South Wales (J. A. Moore, 21 November 1952)

= *Litoria booroolongensis*

Hyla burrowsi Scott

1942, *Rec. Queen Vict. Mus.*, 1:7, pls. 1-3.

PARATYPE: R12563, Dove Lake, Cradle Valley, Tasmania.

= *Litoria burrowsi*

Hyla dorsalis microbelos Cogger

1966, *Aust. Zool.*, 13(3):223, fig. 1, pl. 12.

HOLOTYPE: R25836, Cairns, Queensland (N. Morris, February 1965).

PARATYPES (3): R25837-25839, data as for holotype.

= *Litoria dorsalis*

Hyla ewingii alpina Fry

1915, *Proc. R. Soc. Qd*, 27(4):79.

HOLOTYPE: R4644, Mt. Kosciusko Summit, New South Wales.

PARATYPES (20): R581, R583, R584, Mt. Kosciusko, 5,000 ft, New South Wales (R. Helms); R4645, Mt. Kosciusko, Summit, New South Wales (C. Hedley); R4646, R49949-49957, Mt. Kosciusko, 5,500 ft, New South Wales (C. Hedley); R5055, R5056, R5058, Mt. Kosciusko, 7,000 ft, New South Wales (T. H. Johnstone); R5422, R5424, R5425, Hotel Kosciusko, 5,200 ft, Monaro, New South Wales (A. R. McCulloch).

= *Litoria verreauxii*

Remarks: In original description the series R5055-5056, R5058 is said to contain 4 specimens. It also cites a complete type series of 22 specimens of which only 21 have been located.

Hyla ewingii loveridgei (non Neill, 1954) Copland

1957, *Proc. Linn. Soc. N.S.W.*, 82(1):65.

HOLOTYPE: R18586, near Porter's Retreat, New South Wales (S. J. Copland, 1 May 1946).

= *Hyla ewingii oberonensis* (nom. nov., Copland, 1963, q.v.).

= *Litoria verreauxii*

Hyla ewingii oberonensis Copland

1963, *Proc. Linn. Soc. N.S.W.*, 88(2):107 [nom. nov. pro *Hyla ewingii loveridgei* (non Neill) Copland].

HOLOTYPE: See *Hyla ewingii loveridgei* Copland.

= *Litoria verreauxii*

Hyla iris Tyler

1962, *Rec. S. Aust. Mus.*, 14(2):253.

PARATYPES (5): R16832-16836, Bamna, 6,500 ft, near Nondugl, Papua New Guinea (M. J. Tyler, 16 April 1960).

= *Litoria iris*

Hyla jenolanensis Copland

1957, *Proc. Linn. Soc. N.S.W.*, 82(1):97.

HOLOTYPE: R14412, creek bed near Bottomless Pit, Jenolan Cave, New South Wales (C. Sander, 18 March 1954).

= *Litoria citropa*

Hyla kinghorni Loveridge

1950, *Proc. biol. Soc. Wash.*, 63:132.

HOLOTYPE: R13818, Ulong, New South Wales (J. R. Slevin, 1 January 1948).

= *Litoria lesueurii*

Hyla latopalmata wotjulumensis Copland (emend. pro *watjulumensis*, vide Tyler, 1968)

1957, *Proc. Linn. Soc. N.S.W.*, 82(1):96.

?SYNTYPE: R6011, Napier, Broome Bay, Western Australia.

= *Litoria wotjulumensis*

Remarks: Tyler (1968) argues for the exclusion of this and other specimens from the syntype series on the basis of Copland's reference to Watjulum Mission as the "type locality".

Hyla luteiventris Ogilby

1907, *Proc. R. Soc. Qd*, 20:31.

HOLOTYPE: R4379, Brisbane, Queensland (A. R. McCulloch).

= *Litoria gracilenta*

Remarks: This specimen was located following earlier searches in the Queensland Museum, the museum of the Amateur Fisherman's Association of Queensland and the Australian Museum, as reported by Covacevich (1971:52).

Hyla macgregori Ogilby

1890, *Rec. Aust. Mus.*, 1(5):100.

SYNTYPES (10): R4613, R54693-54695, R54700-54704, R60771, St. Joseph's River district, about 80 miles NW of Port Moresby, Papua New Guinea (Sir William Macgregor).

= *Litoria congenita*

Remarks: For many years all of the above syntypes except R4613 were erroneously cited under the catalogue number R909; R60771 is the specimen figured by Fry, 1915, *Proc. R. Soc. Qd*, 27(4): pl. 2. Remaining 16 syntypes not located.

Hyla micromembrana Tyler

1963, *Trans. R. Soc. S. Aust.*, 86:121.

PARATYPES (2): R17991, R17992, Bilikep, 6,300 ft, on Wahgi-Sepik Divide, Papua New Guinea (M. J. Tyler, 26 March 1960).

= *Litoria micromembrana*

Hyla mintima Tyler

1963, *Trans. R. Soc. S. Aust.*, 86:123.

PARATYPES (2): R17993, R17994, Mintima, 6,000 ft, Chimbu Region, Papua New Guinea (M. J. Tyler, 1 June 1960).

= *Litoria mintima*

Hyla pearsoni (non Gaige) Copland

1960, *Proc. Linn. Soc. N.S.W.*, 85(1):154.

HOLOTYPE: R18588, Cedar Creek, E of Mt. Glorious, about 20 miles NW of Brisbane, Queensland (J. C. Pearson, 8 September 1958).

= *Litoria phyllochroa*

Hyla pearsoniana Copland

1961, *Proc. Linn. Soc. N.S.W.*, 86(1):168 [*nom. nov. pro Hyla pearsoni* (non Gaige) Copland].

HOLOTYPE: See *Hyla pearsoni* Copland.

= *Litoria phyllochroa*

Hyla phyllochroa barringtonensis Copland

1957, *Proc. Linn. Soc. N.S.W.*, 82(1):45.

HOLOTYPE: R9502 (originally R9502A), Cutler's Pass, Williams River, New South Wales (A. Musgrave and T. Campbell, 23-30 October 1926).

PARATYPE: R25916 (originally R9502B), data as for holotype.

= *Litoria phyllochroa*

Hyla phyllochrous nudidigitus Copland

1963, *Proc. Linn. Soc. N.S.W.*, 87(2):137.

HOLOTYPE: R51309, Aberfeldy River, 10 miles by road N of Walhalla, Victoria (J. and C. Copland, 29 December 1961).

PARATYPE: R51310, data as for holotype.

= *Litoria phyllochroa*

Litoria brevipalmata Tyler, Martin and Watson

1972, *Proc. Linn. Soc. N.S.W.*, 97(1):82, figs. 1-2, pl. 2.

PARATYPE: R30835, Ourimbah Creek Road, 2 miles W of Ourimbah, New South Wales (J. Barker, 13 March 1971).

Litoria cooloolensis Liem

1974, *Mem. Qd Mus.*, 17(1):169, fig. 1, pl. 5.

PARATYPES: (2): R37183, R37184, Coolamera Lake, Cooloola, Queensland (D. S. Liem, 27 September 1972).

Litoria flavipunctata Courtice and Grigg

1975, *Aust. Zool.*, 18(3):159, pl. 1.

HOLOTYPE: R40676, Booralong (= Booroolong) Creek Road, 12.8 km W of Guyra, in 30°16'S, 151°33'E, New South Wales.

PARATYPES: (6): R40677-40682, data as for holotype.

Litoria glandulosa (non Bell) Tyler and Anstis

1975, *Rec. S. Aust. Mus.*, 17(5):46, fig. 2.

PARATYPE: R39498, Point Lookout, New South Wales (M. Anstis, May 1973).

Remarks: *Litoria glandulosa* is a junior primary homonym of *Litoria glandulosa* Bell, *Zool. "Beagle"* (Rept. 1843):42.

Litoria guttata Macleay

1877 (1878), *Proc. Linn. Soc. N.S.W.*, 2(2):137.

HOLOTYPE: R29956 (MM R145), Katow (Binaturi River), Papua New Guinea.

= *Litoria infrafronata*

Litoria nyakalensis Liem

1974, *Mem. Qd Mus.*, 17(1):157, fig. 2, pl. 4.

PARATYPES: (2): R37181, Henrietta Creek, Palmerston National Park, northern Queensland (D. S. Liem, 17 October 1972); R37182, Beatrice Creek, Palmerston National Park, northern Queensland (D. S. Liem, 29 November 1971).

Litoria rheocolus Liem

1974, *Mem. Qd Mus.*, 17(1):152, figs. 1, 4, pl. 3A.

PARATYPES: (3): R37178, the Boulders, 5 km W of Babinda, Queensland (D. S. Liem, 10 October 1972); R37179, Shipton's Flat, 50 km S of Cooktown, Queensland (D. S. Liem, 14 October 1972); R37180, Henrietta Creek, Palmerston National Park, Queensland (D. S. Liem, 17 October 1972).

Nyctimystes disrupta Tyler

1963, *Rec. Aust. Mus.*, 26(3):118, fig. 1, pl. 3.

HOLOTYPE: R15923, Kaironk Valley, 6,000 ft, Schrader Mountains, Papua New Guinea (R.N.H. Bulmer, 4 February, 1960).

PARATYPES: (6): R14862, R14865, Yaramanda, W side of Baiyer River, 5,000 ft, Papua New Guinea (R.N.H. Bulmer, 11 September 1955); R15910, R15916, R15921, data as for holotype; R16600, Baiyer River, 5,000 ft, Papua New Guinea (R.N.H. Bulmer, 4 October 1959).

Nyctimystes foricula Tyler

1963, *Rec. Aust. Mus.*, 26(3):120, fig. 2, pl. 3.

HOLOTYPE: R15904, Kaironk Valley, 5,000-6,000 ft, Schrader Mountains, Papua New Guinea (R. N. H. Bulmer, 4 February 1960).

PARATYPES: (5): R15909, R15911, R15918, R15926, R15928, data as for holotype (3-6 February 1960).

Pelodryas militarius Ramsay

1877 (1878), *Proc. Linn. Soc. N.S.W.*, 2(1):28.

HOLOTYPE: R5250, New Ireland (G. Brown).

= *Litoria infrafronata*

Family **Microhylidae**

Aphantophryne pansa Fry

1916, *Proc. Linn. Soc. N.S.W.* 41(4):772, pls. 54, 55.

HOLOTYPE: R5238, Mount Scratchley, 12,200 ft, Owen Stanley Range, Papua New Guinea (A. Giulianetti, September-October 1896).

PARATYPES (4): R25917-25920, data as for holotype.

= *Cophixalus pansus*

Remarks: Remaining paratype not located.

Asterophrys pansa wilhelmana Loveridge

1948, *Bull. Mus. comp. Zool. Harv.*, 101(2):419.

PARATYPE: R13136 (previously R12916), Mt. Wilhelm, 8,000 ft. Bismarck Range, Madang Division, Papua New Guinea (P. J. Darlington, 10 August 1944).

= *Phrynomantis wilhelmana*

Austrochaperina brevipes Fry

1915, *Proc. R. Soc. Qd*, 27(4):61; (see also Fry, 1912, *Rec. Aust. Mus.*, 9(1):pls. 2, 2b).

HOLOTYPE: R2285, Bloomfield River near Cooktown, north-eastern Queensland (G. Hislop, 1897).

= *Sphenophryne fryi*

Austrochaperina gracilipes Fry

1912, *Rec. Aust. Mus.*, 9(1):93, fig. 39, pl. 8, fig. 1.

HOLOTYPE: R4536, Somerset, Cape York, northern Queensland (C. Hedley and A. R. McCulloch, October 1907).

= *Sphenophryne robusta*

Austrochaperina ornata Fry

1912, *Rec. Aust. Mus.*, 9(1):91, fig. 38.

HOLOTYPE: R222, 25 miles inland from Cairns, north-eastern Queensland (E. J. Cairn and R. Grant, 1888).

PARATYPE: R30833 (MM R54), Russell River, north-eastern Queensland.

= *Cophixalus ornatus*

Austrochaperina robusta Fry

1912, *Rec. Aust. Mus.*, 9(1):89, fig. 37, pl. 8, fig. 2a.

HOLOTYPE: R5295, Russell River, northern Queensland.

PARATYPES (8): R2285 (holotype of *A. brevipes*), Bloomfield River near Cooktown, north-eastern Queensland (G. Hislop, 1897); R5296, R30827-30832 (MM R53), Russell River, north-eastern Queensland.

= *Sphenophryne robusta*

Baragenys nana Zweifel

1972, *Bull. Am. Mus. nat. Hist.*, 148(3):444.

PARATYPES (15): R22780, R22782, R22784, R22786, R22788, R22793, R22797, R22800-22802, R22804, R22808, R22809, R22811, R22813, all from Fungoi, Kaironk Valley, Schrader Mountains, Papua New Guinea (H. G. Cogger, 2 January 1964).

Batrachylodes elegans Brown and Parker

1970, *Breviora*, 346:14.

PARATYPES (20): R42736-42755, Mutahi, 3,000-3,600 ft, Bougainville Island, Solomon Islands (F. Parker, 18 May 1966).

Chaperina punctata Van Kampen

1913, *Nova Guinea*, 9:643, pl. 11, fig. 7.

PARATYPE: R30834 (MM R56), Went Range, 1050 m, West Irian (October 1909).

= ?*Sphenophryne macrorhyncha*

Cophixalus biroi darlingtoni Loveridge

1948, *Bull. Mus. comp. Zool. Harv.*, 101(2):423.

PARATYPES (2): R13134, R25921, Toromanbanau, 7,500 ft, Bismarck Range, Madang Division, Papua New Guinea (P. J. Darlington, 10 August 1944).

= *Cophixalus darlingtoni*

Cophixalus exiguus Zweifel and Parker

1969, *Am. Mus. Novit.*, 2390:2, figs. 1-3.

PARATYPES (4): R26842-26845, Mt. Hartley, 23 miles S and 5 miles E of Cooktown, Queensland (F. Parker, 10 June 1968).

Remarks: In the original description Zweifel and Parker incorrectly cite the above paratypes under the series 'R26842-26834'.

Cophixalus saxatilis Zweifel and Parker

1977, *Am. Mus. Novit.*, 2614:2, figs.

PARATYPES (2): R53981, R53982, Black Mountain, near Cooktown, Queensland (J. Barker and G. Grigg).

Hylophorbus rufescens Macleay

1877, (1878) *Proc. Linn. Soc. N.S.W.*, 2(2):136.

HOLOTYPE: R30826 (MMR144), Katow (Binaturi River), Papua New Guinea.

Phrynomantis humicola compta Zweifel

1972, *Bull. Am. Mus. nat. Hist.*, 148(3):473, fig. 53.

PARATYPES (16): R22757, R22759-22761, R22763, R22764, R22766, R22767, R22769, R22770, R22772, R23119, R23120, R23122, R23177, R23178, Kaironk Valley, Schrader Mountains, Papua New Guinea (H. G. Cogger, December 1963 — January 1964).

Sphenophryne fryi Zweifel

1962, *Am. Mus. Novit.*, 2113:26 (*nom. nov. pro Austrochaperina brevipes* [non *Sphenophryne brevipes* (Boulenger), 1897] Fry, 1915).

HOLOTYPE: See *Austrochaperina brevipes* Fry.

Family **Ranidae**

Hypsirana heffernani Kinghorn

1928, *Rec. Aust. Mus.*, 16(3):130, pl. 13, fig. 7.

HOLOTYPE: R8619, Tunabuli Harbour, Ysabel Island, Solomon Islands (N.S. Heffernan).

PARATYPE: R8618, data as for holotype.

= *Palmatorappia solomonis*

Rana jimiensis Tyler

1963, *Rec. Aust. Mus.*, 26(3):126, pls. 4-5.

HOLOTYPE: R14711, Manjim, Ganz River, Papua New Guinea (N. Camps, 16 July 1954).

Class Reptilia

Order Crocodilia

Family **Crocodylidae**

Crocodylus johnsoni Krefft

1873, *Proc. zool. Soc. Lond.* 1873(2): 335.

HOLOTYPE: 4627 (stuffed skin minus head), 4629 (skeleton from same specimen), Upper Herbert River, Queensland (J. G. Blaxland).

= *Crocodylus johnstoni*

Order Testudines

Family **Cheloniidae**

Natator tessellatus McCulloch

1908, *Rec. Aust. Mus.*, 7(2):127, pls. 26-27.

HOLOTYPE: R4158, Port Darwin, Northern Territory (H. W. Christie).

= *Chelonia depressa*

Family **Carettochelyidae**

Carettochelys insculptus Ramsay

1886 (1887), *Proc. Linn. Soc. N.S.W.*, (2)1(1):158, pls. 3-6.

HOLOTYPE: R3677, Fly River, Papua New Guinea.

= *Carettochelys insculpta*

Family **Chelidae**

Chelodina intergularis Fry

1915, *Proc. R. Soc. Qd*, 27(4):88, pl. 4.

HOLOTYPE: R6255, ?Australia.

= *Chelodina rugosa*

Remarks: Shell only.

Chelodina parkeri Rhodin and Mittermeier

1976, *Bull. Mus. comp. Zool. Harv.*, 147(11): 477, fig. 13.

HOLOTYPE: R21425, Mawa, Lake Murray, Western District, Papua New Guinea (H. G. Cogger, 7 November 1963).

PARATYPES (5): R21159, Aketa, Aramia River, Western District, Papua New Guinea (H. G. Cogger, 31 October 1963); R21423, R21424, Mawa, Lake Murray, Papua New Guinea (H. G. Cogger, 7 November 1963); R21353, R21434, Balimo, Papua New Guinea (H. G. Cogger, 29 October 1963).

Chelodina rugosa Ogilby

1890, *Rec. Aust. Mus.*, 1(3):56, pl. 7.

HOLOTYPE: R6256, Cape York, Queensland (J. A. Thorpe, 1869).

Order Squamata
Suborder Sauria

Family **Gekkonidae**

Ceramodactylus damaeus Lucas and Frost

1896, *Rep. Horn Exped. Central Aust.*, 2:119, pl. 9, fig. 2.

PARATYPE: R3855, Charlotte Waters, Northern Territory, (A.H.S. Lucas).

= *Lucasium damaeum*

Diplodactylus annulatus Macleay

1877 (1878), *Proc. Linn. Soc. N.S.W.*, 2(1):97.

LECTOTYPE: R29932 (MM MR762), Palm Islands, N of Townsville, Queensland (*vide* Kluge, 1963).

PARALECTOTYPES (3): R29929 (MM MR759), R29930 (MM MR760), R29931 (MM MR761), data as for lectotype.

= ?*Phyllodactylus annulatus* (*vide* Kluge, 1963).

Diplodactylus intermedius Ogilby

1892, *Rec. Aust. Mus.*, 2(1):10.

LECTOTYPE: R285, Australia (lectotype designated by Kluge, 1967, who also restricted the type locality to Nymagee, New South Wales).

PARALECTOTYPES (2): R286, R287, data as for lectotype.

Diplodactylus williamsi Kluge

1967, *Aust. J. Zool.*, 15:1063, pl. 12, fig. 2.

HOLOTYPE: R14987, Warrumbungle Mountains, New South Wales (H. G. Cogger, 9-10 April 1955).

PARATYPES (20): R2007-2009, Boggabri, New South Wales; R2624, R2625, R2628-2631, R2633, R2634, Tamworth, New South Wales (D. A. Porter); R4775, R60775, Boggabri, New South Wales, (A. H. S. Lucas); R12109, R60776, 'Retro', Capella, Central Queensland (P. C. Allen); R12341, Garah, Moree District, New South Wales (W. Smythe); R14986, Warrumbungle Mountains, New South Wales; R15128, Townsville, Queensland (H. G. Cogger, August 1956); R15138, Mt. Isa, Queensland (D. Stammer, October 1954); R15645, Woodstock via Townsville (W. Hosmer, September 1956).

Gymnodactylus cornutus Ogilby

1892, *Rec. Aust. Mus.*, 2(1):8.

SYNTYPES (6): R748-750, R752, R753, Bellenden Ker Ranges, north-eastern Queensland (Cairns and Grant); R1094, Russell River, northern Queensland (W. S. Day).

= *Phyllurus cornutus*

Gymnodactylus sphyrurus Ogilby

1892, *Rec. Aust. Mus.*, 2(1):6.

HOLOTYPE: R3800, interior of New South Wales (? Tumut, in error).

= *Underwoodisaurus sphyrurus*

Remarks: This and other specimens are erroneously recorded from "Tumut, New South Wales?" in the register.

Heteronota eboracensis Macleay

1877 (1878), *Proc. Linn. Soc. N.S.W.*, 2(1):101.

LECTOTYPE: R29951 (MM MR975) Cape York, Queensland (*vide* Kluge, 1963).

PARALECTOTYPE: R29952 (MM MR976), data as for lectotype.

= *Cyrtodactylus pelagicus*

Heteronota fasciata Macleay

1877 (1878), *Proc. Linn. Soc. N.S.W.*, 2(1):100.

HOLOTYPE: R31934 (MM MR802), Hall Sound, Papua New Guinea.

= *Cyrtodactylus pelagicus*

Heteronota marmorata Macleay

1877 (1878), *Proc. Linn. Soc. N.S.W.*, 2(1):100.

LECTOTYPE: R42733 (MM MR632), Fitzroy Island, Queensland (lectotype designated by Kluge, 1963, who also restricted the type locality to Fitzroy Island).

PARALECTOTYPES (11): R31937 (MM MR905), R31938 (MM MR906), R31939 (MM MR907), R31940 (MM MR908), R31941 (MM MR909), R31942 (MM MR910), R31943 (MM MR911), R31944 (MM MR912), R31945 (MM MR913), Endeavour River, Queensland; R42734 (MM MR634), R42735 (MM MR633), data as for lectotype.

= *Cyrtodactylus pelagicus*

Heteronota walshi Kinghorn

1931, *Rec. Aust. Mus.*, 18(5):268, fig. 2.

HOLOTYPE: R10266, Boggabri, New South Wales (J. Walsh).

PARATYPES (2): R6772, R6773, locality unknown (D. A. Porter).

= *Underwoodisaurus sphyrurus*

Oedura coggeri Bustard

1966, *Bull. Br. Mus. (nat. Hist.). Zool.*, 14(1):9, pls. 1, 3.

HOLOTYPE: R17791, Lappa Junction, northern Queensland (W. Hosmer, 24 January 1954).

PARATYPES (28): R15641, Emuford (W. Hosmer, September 1952); R15644, Irvinebank (W. Hosmer, September 1956); R16679, Herberton (H. G. Cogger, 6 July 1960); R16729-16731, Petford (H. G. Cogger, 7 July 1960); R17771, Petford (W. Hosmer); R17767-17770, Hartley's Creek, nr. Cairns (W. Hosmer, 30 August 1953); R17783, R17785-17790, R17794-17803, data as for holotype.

Oedura tryoni De Vis

1884, *Proc. R. Soc. Qd*, 1(2):54.

NEOTYPE: R21601, Mt. Marlay, Stanthorpe, south-eastern Queensland (H. R. Bustard and P. Maderson, September 1964); *vide* Bustard, 1966.

Peripia brevicaudis Macleay

1877 (1878), *Proc. Linn. Soc. N.S.W.*, 2(1):99.

LECTOTYPE: R29947 (MM MR931), Darnley Island, Torres Strait; *vide* Kluge 1963.

PARALECTOTYPES (6): R29944-29946 (MM MR1006-1008), R29948 (MM MR932), R29949 (MM MR933), R29950 (MM MR934), data as for lectotype.

= *Gehyra baliola*

Peripia longicaudis Macleay

1877 (1878), *Proc. Linn. Soc. N.S.W.*, 2(1):98.

HOLOTYPE: R31933 (MM MR974), Endeavour River, Queensland.

= *Gehyra variegata*

Peripia marmorata Macleay

1877 (1878), *Proc. Linn. Soc. N.S.W.*, 2(1):99.

HOLOTYPE: R29943 (MM MR1201), Katow (Binaturi River), Papua New Guinea.

= *Gehyra baliola*

Peripia papuensis Macleay

1877 (1878), *Proc. Linn. Soc. N.S.W.*, 2(1):97.

HOLOTYPE: R29939 (MM MR800), Katow (Binaturi River), Papua New Guinea.

PARATYPE: R29940 (MM MR801), data as for holotype.

= *Hemidactylus frenatus*

Pseudothecadactylus lindneri lindneri Cogger

1975, *Rec. Aust. Mus.*, 30:89, fig. 4.

HOLOTYPE: R38734, vicinity of Koongarra Mining Camp, Mt. Brockman Range, Northern Territory, in 12°51'S, 132°52'E (H. G. Cogger and D. Lindner, 6 March 1973).

PARATYPES (24): R37126, R37127, R37129-37133, Deaf Adder Creek, Northern Territory, in approx. 13°05'S, 132°55'E (B. Bolton and D. Lindner, 18 February 1972); R38730-38733, R38735, near Koongarra Mining Camp, Mt. Brockman Range, Northern Territory, in 12°53'S, 132°50'E (H. G. Cogger and D. A. Lindner, 1 March 1973); R38945, R38946, near Koongarra Mining Camp, Mt. Brockman Range, Northern Territory, in 12°53'S, 132°50'E (H. G. Cogger and D. A. Lindner, 2 March 1973); R39493, R39975, R39992, Nourlangie Rock, Mt. Brockman Range, Northern Territory, in 12°52'S, 132°48'E (H. G. Cogger, 29-30 July 1973); R39496, R39497, R39520, R39521, Deaf Adder Creek, Northern Territory, in approx. 13°05'S, 132°55'E (H. G. Cogger and P. Webber, 4 August 1973); R39522, R39895, R40283, Cannon Hill, Northern Territory (H. G. Cogger, 27 July 1973).

Family **Pygopodidae***Aprasia inaurita* Kluge

1974, *Misc. Publs Mus. Zool. Univ. Mich.*, 147:51, figs. 21, 32.

PARATYPE: R14382, Wudinna, South Australia (Kempster, December 1953).

Aprasia parapulchella Kluge

1974, *Misc. Publs Mus. Zool. Univ. Mich.*, 147:53, figs. 22-23, 27, 115-116.

PARATYPES (4): R31632-31635, Coppins Crossing, Australian Capital Territory (R. Jenkins, 9 May 1969).

Aprasia striolata glauerti Parker

1956, *Bull. Br. Mus. (nat. Hist). Zool.*, 3(9):378, fig. 3a.

PARATYPES (4): R3468, Australia; R12305, R27521, R27522, Tambellup, Western Australia (F. R. Bradshaw).

Delma borea Kluge

1974, *Misc. Publs Mus. Zool Univ. Mich.*, 147:81, figs. 44-47, 124.

PARATYPES (20): R3662, R62673, Port Darwin, Northern Territory (Christie and Godfrey); R4162, Port Darwin, Northern Territory (H. W. Christie); R8249, Darwin, Northern Territory (W. E. J. Paradise); R12794, R12841, R13004, Darwin area, Northern Territory (T. R. Tovell, 1944); R12877, Darwin, Northern Territory (E. Worrell, 16 July 1944); R12901, West Head, Darwin, Northern Territory; R13471, R13609, Groote Eylandt, Northern Territory (J. E. Bray, June 1948); R13569, R13570, R13648, R62670-62672, Cape Arnhem, Northern Territory (J. E. Bray, July-August 1948); R13713, R13777, Nightcliff, Northern Territory (A. C. Greville); R19121, Darwin, Northern Territory.

Delma inornata Kluge

1974, *Misc. Publs Mus. Zool. Univ. Mich.*, 147:101, figs. 58, 62-64.

PARATYPES (22): R679-682, R952, Cootamundra, New South Wales (H. J. McCooey); R973, Yandembah, New South Wales (K. H. Bennett); R6988, Gerogery, New South Wales (A. Murray); R10118, R10126, Barmedman, New South Wales (C. Cooke); R10497, R10498, Hillston, New South Wales (G. Johnson); R11763, Quantong, Victoria (C. F. Kurtze); R13890, Finley, New South Wales; R15451, Pericoota, via Moama, New South Wales (J. Rudder); R15946, Holbrook, New South Wales (K. Nixon); R17163, Yanco, New South Wales (E. L. Jones, 30 March 1961); R17982, Nymagee, New South Wales (H. G. Cogger); R20587, Moombooldool, New South Wales (K. G. Darrington, 13 August 1963); R20729, Wymah, New South Wales (Principal of Wymah Public School); R27922, Round Hill Fauna Reserve, New South Wales (H. G. Cogger, March 1969); R27986, Albury, New South Wales (J. Dixon); R30329, Riverina district, New South Wales.

Delma torquata Kluge

1974, *Misc. Publs Mus. Zool. Univ. Mich.*, 147:125, figs. 6, 43, 85-86.

PARATYPE: R12611, Ulam, Queensland (L. Shirley).

Lialis burtonis Gray

1835 (1834), *Proc. zool. Soc. Lond.*, 1834:134.

NEOTYPE: R27914, Round Hill Fauna Reserve, between Lake Cargelligo and Mt. Hope, in 32°58'S, 146°10'E, New South Wales (H. G. Cogger, 1967); *vide* Kluge, 1974.

Family Agamidae

Amphibolurus barbatus minimus Loveridge

1933, *Proc. New Engl. zool. Club*, 13:69.

PARATYPES (3): R10878, R10879, Hermannsburg, Northern Territory (H. A. Barry); R11371, West Wallabi Island, Houtman Abrolhos, Western Australia (W. E. Scheville, 10 October 1931).

= *Amphibolurus minimus*

Amphibolurus nobbi nobbi Witten

1972, *Herpetologica*, 28(3):191, fig. 1.

HOLOTYPE: R33440, 24 miles ENE Guyra, New South Wales (G. J. Witten, 20 October 1971).

PARATYPES (100): R33303-33328, Bolivia Hill, 20.5 miles S Tenterfield, on Glen Innes Road, New South Wales (G. Witten, 14 March 1971); R33329, 18 miles S Grafton, on Pacific Highway, New South Wales (19 December 1970); R33330, R33441-33445, R33480, Baker's Creek Gorge, 17 miles E Armidale, New South Wales (G. Witten, 8 January 1971); R33424-33439, R33446-33451, data as for holotype; R33452-33455, Moonbi Ranges, 17 miles NE Tamworth on Armidale Road, New South Wales (G. Witten, 6 February 1971); R33456-33459, 24 miles S Tenterfield on Glen Innes Road, New South Wales (G. Witten, 13 February 1971); R33460, Tea Tree Creek, 12 miles W Armidale on Bundarra Road, New South Wales (H. Heatwole, 4 January 1970); R33461, 13 miles E Tenterfield on Casino Road, New South Wales (G. Witten, 27 March 1971); R33462, Aquatic Pool, 2 miles S Copeton, New South Wales (G. Witten, 18 January 1968); R33463, 6 miles N Wallangarra on Stanthorpe Road, Queensland (G. Witten, 14 February 1971); R33464-33474, 5 miles N Wallangarra on Stanthorpe Road, Queensland (G. Witten, 13 March 1971); R33475, 1 mile E Ballandean on Eukey Road, Queensland (G. Witten, 14 February 1971); R33476-33479, Armidale district, New South Wales (G. Witten); R33481, 4 miles W Yarrowyck on Kingston Road, New South Wales (External students, U.N.E., 7 January 1969); R33482, Moonbi area about 18 miles ENE Tamworth, New South Wales (External students, U.N.E., 17 September 1970); R33483, Yarrowyck, New South Wales (External students, U.N.E. January 1968); R33484, Stanthorpe, Queensland (External students, U.N.E., 9 January 1971); R33485-33487, 5 miles N Wallangarra, 1 mile E New England Highway, Queensland (External students, U.N.E., 14 February 1971); R33488-33491, Point Lookout area near Ebor, New South Wales (External students, U.N.E., 13 March 1967); R33492-33496, no locality (External students, U.N.E.).

Amphibolurus nobbi coggeri Witten

1972, *Herpetologica*, 28(3):192, fig. 2.

HOLOTYPE: R17660, Warrumbungle Mountains, New South Wales (H. G. Cogger and R. D. Mackay, 14 September 1961).

PARATYPES (21): R2866, Inverell, New South Wales (D. A. Porter); R2868, no locality (D. A. Porter); R14983-14985, Warrumbungle Mountains, New South Wales (H. G. Cogger, 9-10 April 1955); R15124, R15125, R17944, Warrumbungle Mountains, New South Wales (H. G. Cogger); R17661, data as for holotype; R17932, Nymagee, New South Wales (H. G. Cogger, 1 November 1961); R18475, Nymagee, New South Wales (H. G. Cogger); R19018, Nymagee, New South Wales (H. G. Cogger, 17 November 1962); R19297, Nymagee, New South Wales (H. G. Cogger, 27 March 1963); R21599, R21600, Pilliga, New South Wales (H. R. Bustard); R29688, R29698, R29699, Round Hill Fauna Reserve, between Lake Cargelligo and Mt. Hope, New South Wales (H. G. Cogger, November 1967); R30356-30358, Hillston, New South Wales (R. Miller, 10 April 1970).

Diporiphora linga Houston

1977, *Trans. R. Soc. S. Aust.*, 101(8): 203.

PARATYPES (2): R54626, R54627, 407 miles, E-W line (= Immarna) South Australia (1 October 1921, E. Le G. Troughton and J. H. Wright).

Grammatophora jugularis Macleay

1877 (1878), *Proc. Linn. Soc. N.S.W.*, 2(1):104.

SYNTYPES (3): R40672 (MM MR920), R40673 (MM MR921), R40674 (MM MR922), Cape Grenville, Queensland.

= *Diporiphora bilineata*

Lophognathus lateralis Macleay

1877 (1878), *Proc. Linn. Soc. N.S.W.*, 2(1):103.

HOLOTYPE: R31882 (MM MR723), Katow (Binaturi River), Papua New Guinea.

= *Lophognathus temporalis*

Physignathus gilberti centralis Loveridge

1933, *Proc. New Engl. zool. Club*, 13:71.

PARATYPE: R10993, Anningie, 30 miles W of Teatree Well, Northern Territory (W. E. Schevill, 11 September 1932).

= *Lophognathus gilberti*

Tiaris Boydii Macleay

1884, *Proc. Linn. Soc. N.S.W.*, 8(4):432.

SYNTYPES (2): R31884 (MM MR1003), R31885 (MM MR1004), Herbert River, northern Queensland.

= *Gonocephalus boydii*

Tiaris Longii Macleay

1877 (1878), *Proc. Linn. Soc. N.S.W.*, 2(1):103.

HOLOTYPE: R31935 (MM MR831), northern Queensland.

= *Gonocephalus godeffroyi*

Remarks: This specimen represents the only recorded occurrence of *Gonocephalus godeffroyi* in Australia; the absence of subsequent records of this large and striking lizard makes the type locality of *Tiaris Longii* highly suspect.

Tiaris papuensis Macleay

1877 (1878), *Proc. Linn. Soc. N.S.W.*, 2(1):101.

HOLOTYPE: R31883 (MM MR833), Hall Sound, Papua New Guinea.

= *Gonocephalus papuensis*

Tympanocryptis maculosa Mitchell

1948, *Rec. S. Aust. Mus.*, 9(1):78, fig. 9, pl. 5, fig. 8.

PARATYPE: R13440, Lake Eyre, South Australia (C. T. Madigan, August 1920.)

= *Amphibolurus maculosus*

*Family Varanidae**Varanus boulengeri* Kinghorn

1923, *Rec. Aust. Mus.*, 14(2):135, pls. 17, 18.

HOLOTYPE: R8083, Coquet Island, Howick Group, Queensland (C. Hedley).

PARATYPES (2): R6144, R6735, Townsville, Queensland (F. Taylor).

= *Varanus semiremex*

Varanus bulliwallah Worrell

1956, *Aust. Zool.*, 12(3):201, pls. 27-29.

HOLOTYPE: R14810, Bulliwallah Station, on the Belyando River, via Clermont, Queensland (E. Worrell).

= *Varanus mertensi*

Varanus mitchelli Mertens

1958, *Senckenberg. biol.*, 39(5/6):256, pls. 27, 31.

PARATYPE: R9913, Roper River, Northern Territory (K. Langford Smith, 2 February 1929).

Varanus punctatus orientalis Fry

1913, *Rec. Aust. Mus.*, 10(2):18, figs. 7, 9.

HOLOTYPE: R5313, Upper Burnett River, Queensland (Bancroft, Cleland and Johnstone).

PARATYPES (5): R5328, R5901-5903, Eidsvold, near Gayndah, Upper Burnett River, Queensland (Bancroft); R5398, Dawson River, Queensland (H. Pearce).

= *Varanus tristis*

Varanus timorensis similis Mertens

1958, *Senckenberg. biol.*, 39(5/6):239, pl. 24, fig. 2, pl. 28, fig. 9.

HOLOTYPE: R10207, Groote Eylandt, Northern Territory (H. E. Warren).

Family **Scincidae***Ablepharus Boulengeri* Ogilby

1890, *Rec. Aust. Mus.*, 1(1):10.

LECTOTYPE: R690, Cootamundra, New South Wales (H. J. McCooey); *vide* Smyth, 1972.

PARALECTOTYPES (4): R687-689, R691, data as for lectotype.

= *Morethia Boulengeri*

Remarks: Catalogue entry indicates that R690 was regarded as the holotype ('type') by the describer.

Ablepharus burnetti Sydneyensis Copland

1949 (1948), *Proc. Linn. Soc. N.S.W.*, 73(5/6):362.

HOLOTYPE: R18589, Mt. Riverview Lookout, near Blaxland, New South Wales (S. J. Copland, 21 May 1946).

= *Carlia burnetti*

Ablepharus davisii Copland

1952, *Proc. Linn. Soc. N.S.W.*, 77(3/4):121, figs. 2, 3, pl. 5.

HOLOTYPE: R18584, Harding Ranges, 8 miles W to 8 miles NW from Munja Station, Walcott Inlet, Western Australia (Consett Davis, 17 August 1943).

= *Proablepharus tenuis*

Ablepharus kinghorni Copland

1947, *Proc. Linn. Soc. N.S.W.*, 71(5/6):282, figs. 2, 3, pl. 22.

HOLOTYPE: R6458A, Darling River, between Bourke and Wilcannia, New South Wales (R. Helms, May-June 1890), not located.

PARATYPES (5): R6458 (R6458B in original description), R6459, R6460, R25914, R25915, data as for holotype.

= *Proablepharus kinghorni*

Ablepharus rhodonoides Lucas and Frost

1896, *Proc. Linn. Soc. N.S.W.*, 21(3):281.

SYNTYPE: R4156, Mildura, Victoria (W. Fields).

= *Lerista muelleri*

Remarks: Second syntype not located.

Carlia amax Storr

1974, *Rec. West. Aust. Mus.*, 3(2):160.

PARATYPES (18): R12837, Gorrie, Northern Territory (E. Worrell, 2 October 1944); R38815, R38816, R38818-38820, R38824, R38826, R38827, R38829, R38831, Koongarra, Mt. Brockman Range, Arnhem Land, Northern Territory (H. G. Cogger and D. Lindner, 24 February 1973); R39994, R39995, Koongarra, Mt. Brockman Range, Arnhem Land, Northern Territory; R39683, R39684, R39882, Cannon Hill, Northern Territory (H. G. Cogger and P. Webber, 25-26 July 1973); R40253, R40254, Deaf Adder Creek, Northern Territory (H. G. Cogger and P. Webber, August 1973.)

Carlia gracilis Storr

1974, *Rec. West Aust. Mus.*, 3(2):158.

PARATYPES (24): R12715, R60858-60864, Darwin, Northern Territory (cited from Yirrkala, Northern Territory by Storr, 1974) (N.R. Laird); R38685, Tortilla Flats, about 100 km SSE of Darwin; R38822, R38823, R38830, R38832-38837, R38839, Ranger's Station, Woolwonga Reserve, Arnhem Land, Northern Territory (H. G. Cogger and D. Lindner, 5 March 1973); R39881, Cannon Hill, Northern Territory (H. G. Cogger and P. Webber, 26 July 1973); R39993, Nourlangie Rock, Mt. Brockman Range, Northern Territory (H. G. Cogger and P. Webber); R40009, R40010, R40138, Baroalba Creek, Mt. Brockman Range, Arnhem Land, Northern Territory (H. G. Cogger and P. Webber, 1 August 1973).

Carlia johnstonei grandensis Storr

1974, *Rec. West Aust. Mus.*, 3(2):164.

HOLOTYPE: R13464, Groote Eylandt, Northern Territory (J. E. Bray, June 1948).

PARATYPE: R55684, data as for holotype.

Ctenotus alacer Storr

1970 (1969), *J. R. Soc. West. Aust.*, 52(4):104.

PARATYPES (2): R12016, Mt. Gillen, 4 miles N Alice Springs, Northern Territory (H. O. Fletcher and W. Barnes); R14193, Mt. Conway, 34 miles W Alice Springs, Northern Territory (Australian Museum party, Expedition to NW Australia).

Ctenotus decaneurus Storr

1970 (1969), *J. R. Soc. West. Aust.*, 52(4):104.

PARATYPE: R13005, Darwin area, Northern Territory (N. R. Laird, 1944).

Ctenotus militaris Storr

1975, *Rec. West Aust. Mus.*, 3(3):231.

PARATYPE: R45600 (ex WAM R45558), Lake Argyle, Ord River, Western Australia (Western Australian Museum survey party, 28 January 1972).

Ctenotus robustus Storr

1970 (1969), *J. R. Soc. West. Aust.*, 52(4):100.

PARATYPES (4): R3663, Darwin, Northern Territory (Christie and Godfrey); R4981, Darwin, Northern Territory (Christie); R14223, R14230, Port Keats Mission, Northern Territory (Australian Museum party to NW Australia).

Cyrtodactylus galgajuga Ingram

1978, *Vict. Nat.*, 95(4): 142, pl. 1, fig. 2, pl. 2.

PARATYPE: R70110, near Black Mountain (15°40'S, 145°14'E), Trevethan Range, 22 km S of Cooktown, Queensland (W. Hosmer, 1977).

Egernia formosa Fry

1914, *Rec. West. Aust. Mus.*, 1(3):184, fig. 4, pl. 27.

HOLOTYPE: R3058, Perth, Western Australia (W. D. Campbell).

PARATYPES (2): R3059, R3060, data as for holotype.

Egernia geophana Anon. (Horton) — ?*nomen nudum*

1968, *The Armidale Express*, Feb. 7, p. 5, fig.

HOLOTYPE: R26623, Yarrowyck, 20 miles W Armidale, New South Wales (J. le G. Brereton, 11 January 1968).

PARATYPES (4): R26624-26626, 3 miles N Aberfoyle, New South Wales (D. R. Horton, 18 October 1967); R26627, 3 miles N Aberfoyle, New South Wales (D. R. Horton, 9 May 1967).

= *Egernia modesta*

Remarks: The status of the above description is equivocal. It would appear to fulfil the criteria of availability under Articles 11-14 of the International Code of Zoological Nomenclature, but the question of anonymity (Article 15) will probably require resolution by the International Commission for Zoological Nomenclature.

Egernia hosmeri Kinghorn

1955, *Rec. Aust. Mus.*, 23(5):286, pl. 14.

HOLOTYPE: R12927, Kaban, Queensland (R. V. Southcott, September 1945). Cited as R12947 in error by Kinghorn.

PARATYPES (2): R14377, R14378, Lappa Junction nr. Chillagoe, Queensland (W. Hosmer).

Egernia margaretae margaretae Storr

1968, *J. R. Soc. West. Aust.*, 51(2):53.

PARATYPES (2): R17271, Piltadi Rockhole, Mann Ranges, South Australia (H. G. Cogger, H. Hughes and R. D. Mackay, 12 June 1961); R17456, Erliwunyawunya Rockhole, Musgrave Ranges, South Australia (H. G. Cogger, H. Hughes and R. D. Mackay, 8 June 1961).

Egernia margaretae personata Storr

1968, *J. R. Soc. West. Aust.*, 51(2):53.

PARATYPES (2): R16628, R16629, Wilpena Pound, Flinders Ranges, South Australia (F. J. Mitchell, 3 May 1960).

Egernia saxatilis intermedia Cogger

1960, *Rec. Aust. Mus.*, 25(5):96, pl. 2, figs. 2, 3, 5.

HOLOTYPE: R15273, Kanangra Walls, 3,400 ft., New South Wales (H. G. Cogger, 2 April 1959).

PARATYPES (3): R15270-15272, data as for holotype.

Egernia saxatilis saxatilis Cogger

1960, *Rec. Aust. Mus.*, 25(5):96, pl. 2, figs 1 and 6.

HOLOTYPE: R15282, Warrumbungle Mountains, New South Wales (H. G. Cogger, December 1958).

PARATYPES (9): R14524, Tonduron Mt., Warrumbungle Mountains, New South Wales (H. G. Cogger); R14968, R14969, Warrumbungle Mountains, New South Wales (9-10 April 1955); R15283, R15289, data as for holotype; R15561-15564, Warrumbungle Mountains, New South Wales (H. G. Cogger, 4-5 October 1959).

Egernia whitei canarae Kinghorn

1931, *Rec. Aust. Mus.*, 18(3):88.

HOLOTYPE: R9981, between Canara district and North West Cape, Western Australia (D. G. Stead, August 1929); R12346, Northam, Western Australia (C. G. Jessup).

= *Ctenotus pantherinus*

Egernia whitei modesta Storr

1968, *J.R. Soc. West. Aust.*, 51(2):55.

PARATYPES (8): 5014-5016, no data; 5535, 5536, Gayndah, Queensland (Masters); R1824, Moree, New South Wales (C. J. McMasters); R2894 Tenterfield, New South Wales (D. A. Porter); R5314, Eidsvold, Queensland (Bancroft, Cleland and Johnstone).

= *Egernia modesta*

Eumeces brunneus Macleay

1877, *Proc. Linn. Soc. N.S.W.*, 2(1):65.

SYNTYPES (3): R31864 (MM MR242), R31865 (MM MR243), R31866 (MM MR244), Darnley Island, Torres Strait.

= *Eugongylus rufescens*

Euprepis longicaudis Macleay

1877, *Proc. Linn. Soc. N.S.W.*, 2(1):68.

SYNTYPES (5): R31856 (MM MR537), R31857 (MM MR538), R31858 (MM MR539), R31859 (MM MR540), R31860 (MM MR541), Darnley Island, Torres Strait.

= *Emoia cyanogaster*

Euprepis simillimus Macleay

1877 (1878), *Proc. Linn. Soc. N.S.W.*, 2(1):69.

SYNTYPES (3): R31853 (MM MR440), R31854 (MM MR438), R31855 (MM MR439), Katow (Binaturi River), Papua New Guinea.

= *Emoia cyanogaster*

Euprepis submetallicus Macleay

1877 (1878), *Proc. Linn. Soc. N.S.W.*, 2(1):69.

?HOLOTYPE: R31861 (MM MR518), Hall Sound, Papua New Guinea.

= *Emoia submetallica*

Remarks: Goldman *et al.* (1969) cite three specimens — MM MR518 (AM R31861), MM MR519 (AM R31862), MM MR520 (AM R31963) — as syntypes. However, the original description refers to a single specimen; on the basis of dimensions and scalation, R31861 most closely resembles that description, despite a significant disparity in total length. R31862 is a specimen of *Emoia atrocostata* and R31863 is *E. submetallica* (A. E. Greer, pers. comm.).

Hemiergis decresiensis davisii Copland

1946 (1945), *Proc. Linn. Soc. N.S.W.*, 70(3/4):79, pl. 6, fig. 4.

HOLOTYPE: R58733, Poison Swamp Creek 2.7 miles S Bendemeer near New England Highway, New South Wales (S. J. Copland, 5 December 1940).

PARATYPES (4): R58734-58737, data as for holotype.

Hemiergis decresiensis talbingoensis Copland

1946 (1945), *Proc. Linn. Soc. N.S.W.*, 70(3/4): 71, pl. 6, fig. 3.

HOLOTYPE: R57654 Talbingo, in 35°34'S, 148° 20'E, 1300 ft., New South Wales (S. J. Copland, 3 December 1943).

PARATYPES (42): R12084, R64221, Talbingo, New South Wales (J. C. Wiburd); R57586, 1.8 miles from Talbingo on Kiandra Road, New South Wales (S. J. Copland, 28 January 1943); R57622-57653, R57655-57660, R57672, Talbingo, New South Wales (S. J. Copland, November-December 1943).

Heteropus Cheverti Macleay

1877 (1878), *Proc. Linn. Soc. N.S.W.*, 2(1):67.

SYNTYPES (2): R31876 (MM MR384), R31877 (MM MR385), Barrow Island, Queensland.
= *Carlia fusca*

Heteropus longipes Macleay

1877 (1878), *Proc. Linn. Soc. N.S.W.*, 2(1):66.

HOLOTYPE: R31878 (MM MR427), Endeavour River, Queensland.
= *Carlia fusca*

Heteropus quinquecarinatus Macleay

1877 (1878), *Proc. Linn. Soc. N.S.W.*, 2(1):67.

SYNTYPES (5): R31871 (MM MR422), R31872 (MM MR423), R31873 (MM MR424), R31874 (MM MR425), R31875 (MM MR426), Darnley Island, Torres Strait.
= *Carlia fusca*

Heteropus sexdentatus Macleay

1877 (1878), *Proc. Linn. Soc. N.S.W.*, 2(1):67.

SYNTYPES (3): R31879 (MM MR462), R31880 (MM MR463), R31881 (MM MR464), Cape Grenville, Queensland.
= *Carlia fusca*

Heteropus variegatus Macleay

1877 (1878), *Proc. Linn. Soc. N.S.W.*, 2(1):66.

SYNTYPES (3): R31868 (MM MR389), R31869 (MM MR390), R31870 (MM MR391), Darnley Island, Torres Strait.
= *Carlia fusca*

Hinulia atrocostata Macleay

1877 (1878), *Proc. Linn. Soc. N.S.W.*; 2(1):62.

HOLOTYPE: R31850 (MM MR381), Katow (Binaturi River), Papua New Guinea.
= *Sphenomorphus nigricaudis*

Hinulia Papuensis Macleay

1877 (1878), *Proc. Linn. Soc. N.S.W.*, 2(1):62.

HOLOTYPE: R31847 (MM MR383), Katow (Binaturi River), Papua New Guinea.
= *Sphenomorphus papuensis*

Hinulia pardalis Macleay

1877 (1878), *Proc. Linn. Soc. N.S.W.*, 2(1):63.

HOLOTYPE: R31837 (MM MR21), Barrow Island, Queensland.

= *Sphenomorphus pardalis*

Hinulia Spaldingi Macleay

1877 (1878), *Proc. Linn. Soc. N.S.W.*, 2(1):63.

LECTOTYPE: R31844 (MM MR419), Endeavour River, northern Queensland (*vide* Copland, 1947).

PARALECTOTYPES (3): R31843 (MM MR418), R31845 (MM MR420), R31846 (MM MR421), data as for lectotype.

= *Ctenotus spaldingi*

Lygosoma (Emoa) spenceri Lucas and Frost

1894, *Proc. R. Soc. Vict.*, n.s. 6:81, pl. 2, figs. 1, 1a.

?PARALECTOTYPE: R3991, Gisborne, Victoria.

= *Pseudemoia spenceri*

Lygosoma fragile Macleay

1877 (1878), *Proc. Linn Soc. N.S.W.*, 2(1):64.

SYNTYPE: R31849 (MM MR392), Hall Sound, Papua New Guinea.

= *Sphenomorphus fragilis*.

Lygosoma (Hinulia) breviunguis Kinghorn

1932, *Rec. Aust. Mus.*, 18(6):300, fig. 1.

HOLOTYPE: R9981, Carnarvon district, North West Cape, Western Australia (D. G. Stead, August 1929).

= *Ctenotus pantherinus*

Lygosoma (Hinulia) isolepis foresti Kinghorn

1932, *Rec. Aust. Mus.*, 18(7):358.

HOLOTYPE: R10001, Forest River, East Kimberley, Western Australia (L. Wood, 1929).

= *Sphenomorphus isolepis*

Lygosoma (Hinulia) quoyi kosciuskoi Kinghorn

1932, *Rec. Aust. Mus.*, 18(7):359.

HOLOTYPE: R4654, Mt. Kosciusko, 5,000 ft, New South Wales (C. Hedley).

PARATYPES (4): R558, R559, Mt. Kosciusko, 5,000 ft, New South Wales (R. Helms); R4832, no data; R5061, Mt. Kosciusko, 7,000 ft, New South Wales (T. H. Johnstone).

= *Sphenomorphus kosciuskoi*

Lygosoma (Hinulia) tenuis intermedius Kinghorn

1932, *Rec. Aust. Mus.*, 18(7):358.

HOLOTYPE: R6485, Richmond River, New South Wales (R. Helms).

PARATYPES (5): R328, R60865, Ballina, New South Wales (J. Thorpe); R4990, Dorrigo, New South Wales (F. Taylor); R6484, data as for holotype; R7079, East Dorrigo, New South Wales (W. Heron).

= *Sphenomorphus murrayi*

Lygosoma (Liolepisma) papuae Kinghorn

1928, *Rec. Aust. Mus.*, 16(6):292, fig. 2.

HOLOTYPE: R9357, Mount Lamington district, Papua New Guinea (C. T. McNamara).

= *Sphenomorphus derooyae*

Lygosoma (Liolepisma) weekesae Kinghorn

1929, *Proc. Linn. Soc. N.S.W.*, 54(2):32, fig.

HOLOTYPE: R9745, Mt. Kosciusko, 5,500 ft, New South Wales (R. Helms, May, 1889).

PARATYPES (3): R563, data as for holotype; R1860, Jenolan district, New South Wales (R. Etheridge); R6356, Bombala, New South Wales.

= *Pseudemoia spenceri*

Lygosoma maccooei Ramsay and Ogilby

1890, *Rec. Aust. Mus.*, 1(1):8.

SYNTYPES (8): R672, R676, R677, R683-686, Cootamundra, New South Wales (H. J. McCooley).

= *Carlia tetradactyla*

Lygosoma ornatum Macleay

1877 (1878), *Proc. Linn. Soc. N.S.W.*, 2(1):64.

HOLOTYPE: R31848 (MM MR367), Endeavour River, northern Queensland.

= *Sphenomorphus pumilus*

Lygosoma (Rhodona) picturatum Fry

1914, *Rec. West. Aust. Mus.*, 1(3):186.

HOLOTYPE: R3102, Boulder, Western Australia (W. D. Campbell).

= *Lerista picturata*

Lygosoma (Riopa) striato-fasciatum Ogilby

1890, *Rec. Aust. Mus.*, 1(1):5.

HOLOTYPE: R742, Howla Island, Solomon Islands.

= *Eugongylus albofasciolatus*

Lygosoma (Siaphos) maccoyi Lucas and Frost

1894, *Proc. R. Soc. Vict.*, n.s. 6:85, pl. 2, figs. 2, 2a.

PARALECTOTYPE: R3856, Victoria (A. H. S. Lucas); *vide* Coventry, 1970.

= *Anotis maccoyi*

Lygosoma truncatum monswilsonensis Copland

1952, *Proc. Linn. Soc. N.S.W.*, 77(3/4):128.

HOLOTYPE: R18587, Wilson's Peak, Macpherson Range, Queensland (S. J. Copland, 10 December 1940).

= *Anomalopus truncatus*

Mabouia irrorata Macleay

1877 (1878), *Proc. Linn. Soc. N.S.W.*, 2(1):66.

HOLOTYPE: R31851 (MM MR188), Hall Sound, Papua New Guinea.

= *Emoia atrocostata*

Mabouia marmorata Macleay

1877 (1878), *Proc. Linn. Soc. N.S.W.*, 2(1):65.

HOLOTYPE: R31852 (MM MR465), Long Island, Torres Strait.

= *Emoia atrocostata*

Mabouia uniformis Macleay

1877 (1878), *Proc. Linn. Soc. N.S.W.*, 2(1):65.

HOLOTYPE: R31867 (MM MR513), Coconut Island, Torres Strait.

= *Eugongylus rufescens*

Mococa nigricaudis Macleay

1877 (1878), *Proc. Linn. Soc. N.S.W.*, 2(1):63.

LECTOTYPE: R31840 (MM MR378), Darnley Island, Torres Strait (*vide* Copland, 1946).

PARALECTOTYPES (4): R31838 (MM MR376), R31839 (MM MR377), R31841 (MM MR379), R31842 (MM MR380), data as for lectotype.

= *Sphenomorphus nigricaudis*

Rhodona stylis Mitchell

1955, *Rec. S. Aust. Mus.*, 11:400, fig. 6.

PARATYPES (30): R13566-13568, R13657, R13658, R60866-60890, Cape Arnhem, Northern Territory (J. E. Bray, July-August 1948).

= *Lerista stylis*

Sphenomorphus pardalis erro Copland

1946, *Proc. Linn. Soc. N.S.W.*, 70(5/6):298, pl. 11, fig. 2.

HOLOTYPE: R6352, no data.

PARATYPE: R6373, no data.

Tiliqua occipitalis auriculare Kinghorn

1931, *Rec. Aust. Mus.*, 18(3):88.

HOLOTYPE: R10080, Broome, Western Australia (A. A. Livingstone, 1929).

= *Tiliqua multifasciata*

Tribolonotus brongersmai Cogger

1972, *Zoöl. Meded., Leiden*, 47(16):202, pl. 1.

HOLOTYPE: R30000, circa 9 miles east of Lorengau, Manus Island, Admiralty Group, Papua New Guinea (H. G. Cogger, H. C. Dessauer and T. Gobble, 25 August 1969).

PARATYPE: R29999, data as for holotype.

Tribolonotus ponceleti Kinghorn

1937, *Rec. Aust. Mus.*, 20(1):1, pl. 1.

HOLOTYPE: R11459, Buin, east Bougainville Island, Solomon Islands (J. B. Poncelet).

Suborder Serpentes

Family Typhlopidae

Typhlops batillus Waite

1893 (1894), *Proc. Linn. Soc. N.S.W.*, (2)9(1):9, pl. 1, figs. 1-3.

HOLOTYPE: R42756 (MM R669), Wagga Wagga, New South Wales.

Remarks: Known only from the type specimen; its affinities have been discussed briefly by McDowell (1974, p.47).

Typhlops infralabialis Waite

1918, *Rec. S. Aust. Mus.*, 1(1):35, fig. 25.

HOLOTYPE: R4609, Malaita, Solomon Islands (T. Caulfield).

= *Typhlina subocularis*

Typhlops keasti Kinghorn

1948, *Rec. Aust. Mus.*, 22:67, figs 1, 3a.

HOLOTYPE: R12856, Jacquinot Bay, New Britain (J. A. Keast, June 1945).

= *Typhlina subocularis*

Typhlops minimus Kinghorn

1929, *Rec. Aust. Mus.*, 17(4):190, fig. 1.

HOLOTYPE: R9692, Groote Eylandt, Gulf of Carpentaria, Northern Territory (H. E. Warren, December 1928).

PARATYPES (3): R9693, R61025, R61026, data as for holotype.

= *Typhlina minima*

Typhlops proximus Waite

1893, *Rec. Aust. Mus.*, 2(5):60, pl. 15, figs. 3-4.

HOLOTYPE: 6411, New South Wales.

= *Typhlina proxima*

Typhlops subocularis Waite

1897, *Rec. Aust. Mus.*, 3(3):69.

HOLOTYPE: R2202, Duke of York Island, Papua New Guinea (G. Brown).

= *Typhlina subocularis*

Remarks: Paratype R2203 (data as for holotype) not located.

Typhlops yirrikalae Kinghorn

1942, *Rec. Aust. Mus.*, 21(2):118, fig. 1.

HOLOTYPE: R12381, Yirrkala Mission Station, near Caledon Bay, Arnhem Land, Northern Territory (W. S. Chaseling).

= *Typhlina yirrikalae*

Family **Boidae***Hypaspistes dipsadides* Ogilby

1891, *Rec. Aust. Mus.*, 1(9):192.

HOLOTYPE: R1087, Papua New Guinea (Royal Geographical Society's Expedition to the Fly River, 1885).

= *Liasis amethystinus*

Liasis taronga Worrell

1958, *Proc. R. zool. Soc. N.S.W.*, 1956-1957: 26, figs. 1-4.

HOLOTYPE: R15001, Lae, Papua New Guinea (T. G. Downs, 1955).

= *Liasis boeleni*

Nardoa crassa Macleay

1885 (1886), *Proc. Linn. Soc. N.S.W.*, 10(1):66.

SYNTYPES (2): B5940, R31886 (MM R877), vicinity of Herbert River, Queensland.

= *Liasis fuscus*

Remarks: Third syntype not located.

Family **Colubridae***Dendrelaphis schlenckeri* Ogilby

1898, *Proc. Linn. Soc. N.S.W.*, 23(3):361.

HOLOTYPE: R2380, Fife Bay in 10°35'S, 150°E, Papua New Guinea (H. P. Schlencker).

= *Dendrelaphis calligaster*

Dendrophis bilorealis Macleay

1884, *Proc. Linn. Soc. N.S.W.*, 8(4):435.

SYNTYPES (3): B5942, R31906 (MM R561), R31907 (MM R562), Herbert River, Queensland.

= *Dendrelaphis punctulatus*

Dendrophis breviceps Macleay

1877 (1878), *Proc. Linn. Soc. N.S.W.*, 2(1):37.

SYNTYPES (3): R31911 (MM R581), R31912 (MM R582), R31913 (MM R583), Katow (Binaturi River), Papua New Guinea.

= *Dendrelaphis lineolatus*

Dendrophis Darnleyensis Macleay

1877 (1878), *Proc. Linn. Soc. N.S.W.*, 2(1):38.

SYNTYPES (2): R31914 (MM R565), R31915 (MM R566), Darnley Island, Torres Strait.

= *Dendrelaphis calligaster*

Dendrophis elegans Ogilby

1891, *Rec. Aust. Mus.*, 1(9):194.

HOLOTYPE: R1089, Papua New Guinea (Royal Geographical Society's Expedition to the Fly River, 1885).

= *Dendrelaphis lineolatus*

Dendrophis gracilis Macleay

1875 (1877), *Proc. Linn. Soc. N.S.W.*, 1:15.

SYNTYPES (3): R31908 (MM R569), R31909 (MM R570), R31910 (MM R571), Townsville, Queensland (Spalding).

= *Dendrelaphis punctulatus*

Dendrophis Katowensis Macleay

1877 (1878), *Proc. Linn. Soc. N.S.W.*, 2(1):37.

SYNTYPES (2): R31916 (MM MR563), R31917 (MM MR564), Katow (Binaturi River), Papua New Guinea.

= *Dendrelaphis calligaster*

Dendrophis papuae Ogilby

1891, *Rec. Aust. Mus.*, 1(9):193.

HOLOTYPE: R1088, Papua New Guinea (Royal Geographical Society's Expedition to the Fly River, 1885).

= *Dendrelaphis lineolatus*

Dipsas Boydii Macleay

1884 (1885), *Proc. Linn. Soc. N.S.W.*, 9(3):548.

HOLOTYPE: R31892 (MM R927), Herbert River, northern Queensland.

= *Boiga irregularis*

Dipsas ornata Macleay

1888 (1889), *Proc. Linn. Soc. N.S.W.*, (2)3(2):416.

HOLOTYPE: R31893 (MM R926), vicinity of King's Sound, Western Australia.

= *Boiga irregularis*

Fordonia Papuensis Macleay

1877 (1878), *Proc. Linn. Soc. N.S.W.*, 2(1):35.

SYNTYPES (3): R31903 (MM MR1464), R31904 (MM MR1465), R31905 (MM MR1466), Katow (Binaturi River), Papua New Guinea.

= *Fordonia leucobalia*

Herbertophis plumbeus Macleay

1884, *Proc. Linn. Soc. N.S.W.*, 8(4):434.

HOLOTYPE: R31895 (MM MR1345), Herbert River, northern Queensland.

= *Stegonotus cucullatus*

Katophis plumbea Macleay

1877 (1878), *Proc. Linn. Soc. N.S.W.*, 2(1):36.

SYNTYPES (4): R31898 (MM R618), R31899 (MM R619), R31900 (MM R620), R31901 (MM R621), Katow (Binaturi River), Papua New Guinea.

= *Amphiesma mairii*

Lycodon Darnleyensis Macleay

1877 (1878), *Proc. Linn. Soc. N.S.W.*, 2(1):38.

HOLOTYPE: R31894 (MM R586), Darnley Island, Torres Strait.

= *Stegonotus cucullatus*

Pappophis flavigastra Macleay

1877 (1878), *Proc. Linn. Soc. N.S.W.*, 2(1):40.

HOLOTYPE: R31887 (MM R982), Katow (Binaturi River), Papua New Guinea.

= *Boiga irregularis*

Pappophis laticeps Macleay

1877 (1878), *Proc. Linn. Soc. N.S.W.*, 2(1):39.

SYNTYPES (4): R31888 (MM R936), R31889 (MM R937), R31890 (MM R938), R31891 (MM R939), Hall Sound, Papua New Guinea.

= *Boiga irregularis*

Pseudoferania macleayi Ogilby

1890 (1891), *Proc. Linn. Soc. N.S.W.*, (2)5(1):51.

HOLOTYPE: R460, Ripple Creek, Herbert River, Queensland.

= *Enhydryis polylepis*

Tropidonotus angusticeps Macleay

1884, *Proc. Linn. Soc. N.S.W.*, 8(4):433.

HOLOTYPE: R31902 (MM R591), Ripple Creek district, Herbert River, northern Queensland.

= *Amphiesma mairii*

Tropidonotus ater Macleay

1885 (1886), *Proc. Linn. Soc. N.S.W.*, 10(1):67.

HOLOTYPE: B5943, vicinity of Herbert River, Queensland.

= *Amphiesma mairii*

Family **Elapidae**

Acanthophis laevis Macleay

1877 (1878), *Proc. Linn. Soc. N.S.W.*, 2(1):40.

HOLOTYPE: R31932 (MM R693), Katow (Binaturi River), Papua New Guinea.

= *Acanthophis antarcticus*

Acanthophis praelongus Ramsay

1877 (1878), *Proc. Linn. Soc. N.S.W.*, 2(1):72.

HOLOTYPE: R451, Cape York, Queensland.

= *Acanthophis antarcticus*

Apisthocalamus lamingtoni Kinghorn

1928, *Rec. Aust. Mus.*, 16(6):290, fig. 1.

HOLOTYPE: R9351, Mt. Lamington district, Papua New Guinea (C. T. McNamara).

PARATYPES (2): R9352, R61027, data as for holotype.

?= *Toxicocalamus loriae*

Brachysoma simile Macleay

1878, *Proc. Linn. Soc. N.S.W.*, 2(3):221.

SYNTYPES (4): R31928 (MM MR1421), R31929 (MM MR1422), R31930 (MM MR1423), R31931 (MM MR1424), Port Darwin, Northern Territory (Spalding).

= *Furina diadema*

Cacophis blackmannii Krefft

1869, *Snakes of Australia*, 77, pl. 12, fig. 9.

HOLOTYPE: 6674, Pine Mountain, near Ipswich, Queensland.

= *Furina diadema*

Cacophis fordei Krefft

1869, *Snakes of Australia*, 75, pl. 12, fig. 8.

HOLOTYPE: 6672, Pine Mountain, near Ipswich, Queensland (G. Masters).

= *Cacophis krefftii*

Cacophis harriettae Krefft

1869, *Snakes of Australia*, 76, pl. 11, fig. 13.

HOLOTYPE: 6676, Warro, Port Curtis, Queensland (F. A. Blackman).

Denisonia dwyeri Worrell

1956, *Aust. Zool.*, 12(3):202, fig. 1.

HOLOTYPE: R14808, Glenmorgan, Queensland (W. Dunmall).

= *Unechis gouldii*

Denisonia melanura boulengeri Waite

1899, *Rec. Aust. Mus.*, 3(5):104, fig.

HOLOTYPE: R2378, Malaita, Solomon Islands (W. G. Ivens).

= *Salomonelaps par*

Denisonia ornata Krefft

1869, *Snakes of Australia*, 82, pl. 11, fig. 4.

HOLOTYPE: 6697, Rockhampton, Queensland (T. Nobbs).

= *Denisonia maculata*

Diemenia angusticeps Macleay

1888 (1889) *Proc. Linn. Soc. N.S.W.*, (2)3(1):417.

HOLOTYPE: R31921 (MM R712), vicinity of King's Sound, Western Australia.

= *Demansia olivacea*

Diemenia atra Macleay

1884 (1885), *Proc. Linn. Soc. N.S.W.*, 9(3):549.

SYNTYPES (2): B5941, R31920 (MM R708), Herbert River, northern Queensland.

= *Demansia atra*

Diemenia Papuensis Macleay

1877 (1878), *Proc. Linn. Soc. N.S.W.*, 2(1):40.

HOLOTYPE: R31919 (MM R713), ? Hall Sound, Papua New Guinea.

= *Demansia papuensis*

Elapocephalus ornaticeps Macleay

1878, *Proc. Linn. Soc. N.S.W.*, 2(3):221.

HOLOTYPE: R31918 (MM MR1305), Port Darwin, Northern Territory.

= *Demansia olivacea*

Furina Ramsayi Macleay

1885 (1886), *Proc. Linn. Soc. N.S.W.*, 10(1):61.

SYNTYPES (3): B5945, B5947, B5948, Milparinka, New South Wales (C. M. King).

= *Pseudonaja modesta*

Remarks: Original register entry in February, 1885, cites Silverton, New South Wales as the type locality.

Glyphodon dunmalli Worrell

1955, *Proc. R. zool. Soc. N.S.W.*, 1953-1954: 41, figs.

HOLOTYPE: R14809, Glenmorgan, Queensland (E. Worrell).

ALLOTYPE: R14017, Gayndah, Queensland (E. Worrell).

Hoplocephalus assimilis Macleay

1885 (1886), *Proc. Linn. Soc. N.S.W.*, 10(1):68.

SYNTYPES (4): B5944, R31923 (MM R507), R31924 (MM R508), R31925 (MM R509), vicinity of Herbert River, Queensland.

= *Cryptophis nigrescens*

Hoplocephalus ater Krefft

1866, *Proc. zool. Soc. Lond.*, 1866: 370.

HOLOTYPE: 6577, Flinder's Range, South Australia, (G. Masters).

= *Notechis ater*

Remarks: Original register entry cites Port Lincoln, South Australia, as the type locality.

Hoplocephalus Bransbyi Macleay

1878 (1879), *Proc. Linn. Soc. N.S.W.*, 3(1):52.

HOLOTYPE: R31922 (MM MR1362), Sutton Forest, New South Wales.

= *Austrelaps superbus*

Hoplocephalus carpentariae Macleay

1887 (1888), *Proc. Linn. Soc. N.S.W.*, (2)2(2):403.

HOLOTYPE: R31926 (MM MR1317), Normanton, Gulf of Carpentaria, Queensland.

= *Suta suta*

Hoplocephalus frontalis Ogilby

1890, *Proc. Linn. Soc. N.S.W.*, (2)4(3):1027.

HOLOTYPE: R655, Narrabri, New South Wales (J. Mosely).

= *Suta suta*

Hoplocephalus mastersii Krefft

1866, *Proc. zool. Soc. Lond.*, 1866: 370.

SYNTYPES (6): 6622-6627, 'Flinder's Range', South Australia (G. Masters).

= *Drysdalia mastersii*

Remarks: H. Ehmann (pers. comm.) has indicated that the above type locality is probably in error, and that the syntypes are more likely to have come from Eyre Peninsula, South Australia.

Hoplocephalus stephensii Krefft

1869, *Snakes of Australia*, 58, pl. 6, fig. 7.

?HOLOTYPE: R37361, Port Macquarie, New South Wales.

Remarks: Despite discrepancies between the above specimen and the original description, catalogue entries would indicate that R37361 is the probable holotype. Originally Aust. Mus. 6588 it was sent on exchange to Hurter (St. Louis) in 1897, from whom it was subsequently acquired by the U.S. National Museum (USNM 55999). The specimen has been returned to The Australian Museum through the courtesy of the late Dr. J. M. Peters.

Hoplocephalus suboccipitalis Ogilby

1892, *Rec. Aust. Mus.*, 2(2):23.

HOLOTYPE: R1127, Moree, New South Wales (R. McMaster).

= *Hemiaspis damelii*

Hoplocephalus waitii Ogilby

1894 (1895) *Proc. Linn. Soc. N.S.W.*, (2)9:261.

HOLOTYPE: 6590, no data.

PARATYPES (3): R1020, Dubbo (E. Loane); R1424, Tamworth (J. D. Ogilby); R61525, no data.

= *Hoplocephalus bitorquatus*

Mainophis robusta Macleay

1877 (1878), *Proc. Linn. Soc. N.S.W.*, 2(1):36.

SYNTYPES (2): R31896 (MM R615), R31897 (MM R616), Katow (Binaturi River), Papua New Guinea.

= *Glyphodon tristis*

Melwardia minima Worrell

1960, *West. Aust. Nat.*, 7(5):132, figs. 1-2.

HOLOTYPE: R16494, Broome, Western Australia (M. Ward).

= *Simoselaps bertholdi*

Notechis ater humphreysi Worrell

1963, *Aust. Rept. Park Rec.*, 2:5, fig. 2, a-c.

HOLOTYPE: R17955, New Year Island, near King Island, Bass Strait (R. Humphreys).

ALLOTYPE: R17954, data as for holotype.

Notechis ater serventyi Worrell

1963, *Aust. Rept. Park Rec.*, 2:3, fig. 1, a-c.

HOLOTYPE: R17953, Chappell Island, Bass Strait (E. Worrell).

Notechis scutatus niger Kinghorn

1921, *Rec. Aust. Mus.*, 13(4):145, pl. 26, figs. 6-8.

HOLOTYPE: R7124, Deep Creek, 20 miles from Kingscote, Kangaroo Island, South Australia.

= *Notechis ater*

Oxyuranus maclennani Kinghorn

1923, *Rec. Aust. Mus.*, 14(1):42.

HOLOTYPE: R7901, Coen, Cape York Peninsula, Queensland (H. L. White, 21 March 1922; skin and skull).

PARATYPE: R7900, Coen, Cape York Peninsula, Queensland (H. L. White, 9 March 1922; skull only.)

= *Oxyuranus scutellatus*

Pseudechis darwiniensis Macleay

1878, *Proc. Linn. Soc. N.S.W.*, 2(3):220.

HOLOTYPE: R31927 (MM R649), Port Darwin, Northern Territory (Spalding).

= *Pseudechis australis*

Pseudelaps christieanus Fry

1915, *Proc. R. Soc. Qd*, 27(4):91, fig. 6.

HOLOTYPE: R4989, Port Darwin, Northern Territory (H. W. Christie).

= *Furina diadema*

Pseudelaps minutus Fry

1915, *Proc. R. Soc. Qd*, 27(4):93, fig. 7.

HOLOTYPE: R3971, Colo Valley, New South Wales (J. Summers).

PARATYPES (2): R6643, Wilde's Meadow, Moss Vale, New South Wales (T. Steel);
R6646, Tamworth or Guntawang, New South Wales (A. H. S. Lucas).

= *Drysdalia mastersii*

Rhynchoelaps campbelli Kinghorn

1929, *Rec. Aust. Mus.*, 17(4):191, fig. 2.

HOLOTYPE: R9387, Almaden, Queensland (W. D. Campbell).

= *Simoselaps semifasciata*

Rhynchoelaps roperi Kinghorn

1931, *Rec. Aust. Mus.*, 18(5):267, fig. 1.

HOLOTYPE: R9930, Roper River, Northern Territory (K. Langford Smith).

= *Simoselaps semifasciata*

Vermicella lunulata Krefft

1869, *Snakes of Australia*, 79, pl. 12, fig. 14.

HOLOTYPE: 6684, upper Burdekin River district, Queensland (Walls).

= *Vermicella annulata*

Family **Hydrophiidae***Aipysurus foliosquama* Smith

1926, *Monograph of the Sea-snakes* (British Museum, London), 22, figs. 11-12.

PARATYPE: R8994, Ashmore Reef, Western Australia (M. H. Smith).

Emydocephalus annulatus Krefft

1869, *Snakes of Australia*, 92.

SYNTYPES (2): R454, R6633, "probably . . . Australian seas".

Emydocephalus tuberculatus Krefft

1869, *Snakes of Australia*, 93.

HOLOTYPE: R455, "probably . . . Australian seas".

= *Emydocephalus annulatus*

Pseudodistira horrida Kinghorn

1926, *Proc. zool. Soc. Lond.*, 1926, 71, fig. 1, pl. 1.

HOLOTYPE: R8640, McCulloch Reef, in 17°20'S, 146°30'E, Great Barrier Reef (W. E. J. Paradise).

PARATYPE: R8351, no data

= *Acalyptophis peronii*

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The following type was located after the manuscript was in press:

Typhlops curtus Ogilby

1892, *Rec. Aust. Mus.*, 2(2):23.

HOLOTYPE: R1132, Walsh River, Gulf of Carpentaria.

= *Typhlina ligatus*

THE SCLERACTINIAN CORAL *ARCHOHELIA* LIVING ON THE COASTAL SHORES OF QUEENSLAND, AUSTRALIA

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SUMMARY

Live colonies of the oculinid genus *Archohelia* Vaughan, previously known only from the fossil records of the West Indies and Central and North America, have been discovered in shallow water off Rat Island on the coast of Central Queensland, Australia.

Archohelia rediviva n. sp. differs from the genotype *A. limonensis* in having the tertiary septa regularly fused to the six secondary septa. The small white colonies of *A. rediviva* with branches up to 10 cm long grow more or less erectly from thin encrusting bases. They occur in 3.5 metres of sheltered, turbid water by the shoreline of a rocky island having no fringing coral reef. The coral is subject to strong tidal currents and large changes in salinity.

There are no hints as to the provenance of this coral from the other occurrences of this genus or *Oculina* in Australia.

INTRODUCTION

The oculinid genus *Archohelia* Vaughan, distinguished from *Oculina* only by the presence of a persistent axial corallite similar to that of *Acropora*, has been thought to be extinct. It has been previously known from the Upper Cretaceous of New Mexico, represented by a number of species in the Eocene of California, Barbados and the Gulf Coast region of the United States, by several species in the Oligocene of the Gulf Coast and the State of Washington, and made a last appearance in the Pliocene of Costa Rica, Florida and California (Durham, 1942; Hertlein and Grant, 1960; Vaughan, 1919, 1927, 1941; Wells, 1933, 1945).

That this genus is neither extinct nor peculiar to the Americas is evidenced by the surprising discovery by the junior author in 1974 of several living colonies of *Archohelia* at Rat Island, Gladstone Harbour, Queensland, the subject of this notice.

SYSTEMATIC ACCOUNT

Order	SCLERACTINIA
Suborder	FAVIINA
Family	OCULINIDAE
Genus	<i>Archohelia</i> Vaughan 1919

Type species — *A. limonensis* Vaughan 1919. Pliocene Costa Rica.

"*Archohelia* differs from *Oculina* solely by having a persistent axial corallite, whereas in *Oculina* there is no axial corallite. Pali or paliform teeth are present on all but the last

cycle. Columella trabecular, with some papillae on its upper surface." (Vaughan, 1919, p. 352.) The generic validity of this single criterion — presence of the axial corallite — is open to some doubt. Although the genus *Acropora* has characteristically a leading (axial) corallite on branch tips in nearly all of its 100 or more species, in several massive species (subgenus *Isopora* of some authors) the apparent lack of axial corallites may be due to the massive mode of growth producing an obliteration, whereas all species of *Oculina* and *Archohelia* have the branching growth habit. For the present *Archohelia* may be provisionally retained as a separate genus.

***Archohelia rediviva* n. sp.**

Fig. 1, a-c; Fig. 2, a-e

DESCRIPTION: Corallum composed of relatively slender (width 5-10 mm) branches up to 10 cm long, with many secondary branchlets, rising from an encrusting base, the whole forming a bushy colony. Calices elevated only 0.5 mm on older branches but up to 3 mm on rapidly growing ones, spaced 2-5 mm apart. Coenosteum dense, very faintly striated and granular, quite smooth on older, thicker branches, weakly costate near calices. Axial calices 3 mm in diameter, radials 2-2.5 mm. Septa of axial and radial corallites arranged regularly in three cycles (6/6/12) with several fourth cycle septa in the largest calices. Third cycle septa regularly united to the second cycle with a well-defined paliform lobe at each junction, and weaker lobes before the first cycle. All septa scarcely exsert, those of the first cycle slightly more prominent. In the axial corallites at tips of rapidly growing branches the septa are thin, with paliform lobes and columellar papillae very weakly developed or absent. Major septa with smooth margins and sides laterally spinulose. Higher cycle septa marginally finely dentate, becoming smooth in older calices.

HABIT: Colonies branching more or less erectly from thin, white, irregularly shaped, encrusting bases, up to 15 cm across, possessing randomly spaced corallites.

MATERIAL EXAMINED: Australian Museum No. G14745 (four pieces from one colony); Queensland Museum, four specimens, Nos. G9833-36.

HOLOTYPE: Queensland Museum No. G9834.

PARATYPES: Queensland Museum Nos. G9833,35,36; Australian Museum No. G14745.

LOCALITY: East side of Rat Island off Gladstone, between Curtis Island and Facing Island, Queensland, Lat. 23°46'S, Long. 151°19'E. Depth 3.5 m. Growing under overhanging rock in sheltered water. Colour of living colonies white. Collected by P. Alderslade, August 1974.

OCCURRENCE

The colonies of *A. rediviva* were discovered at an island close to the central Queensland coast. This locality is composed of the same rock type as the mainland and has no fringing coral reef. The sea water in this locality is quite different from that of the coral reef zone, some 20 miles to the east, being turbid for most of the year and subject to large and rapid changes in salinity during the rainy season.

Rat Island is situated in a narrow water passage which forms a major route of exchange between the water of Port Curtis and that of the open sea. With tide heights in excess of 4 m, the island's shores are subject to currents of considerable velocity. On the seaward side of this island there is an indentation into the rocky shoreline, roughly 'U' shaped,

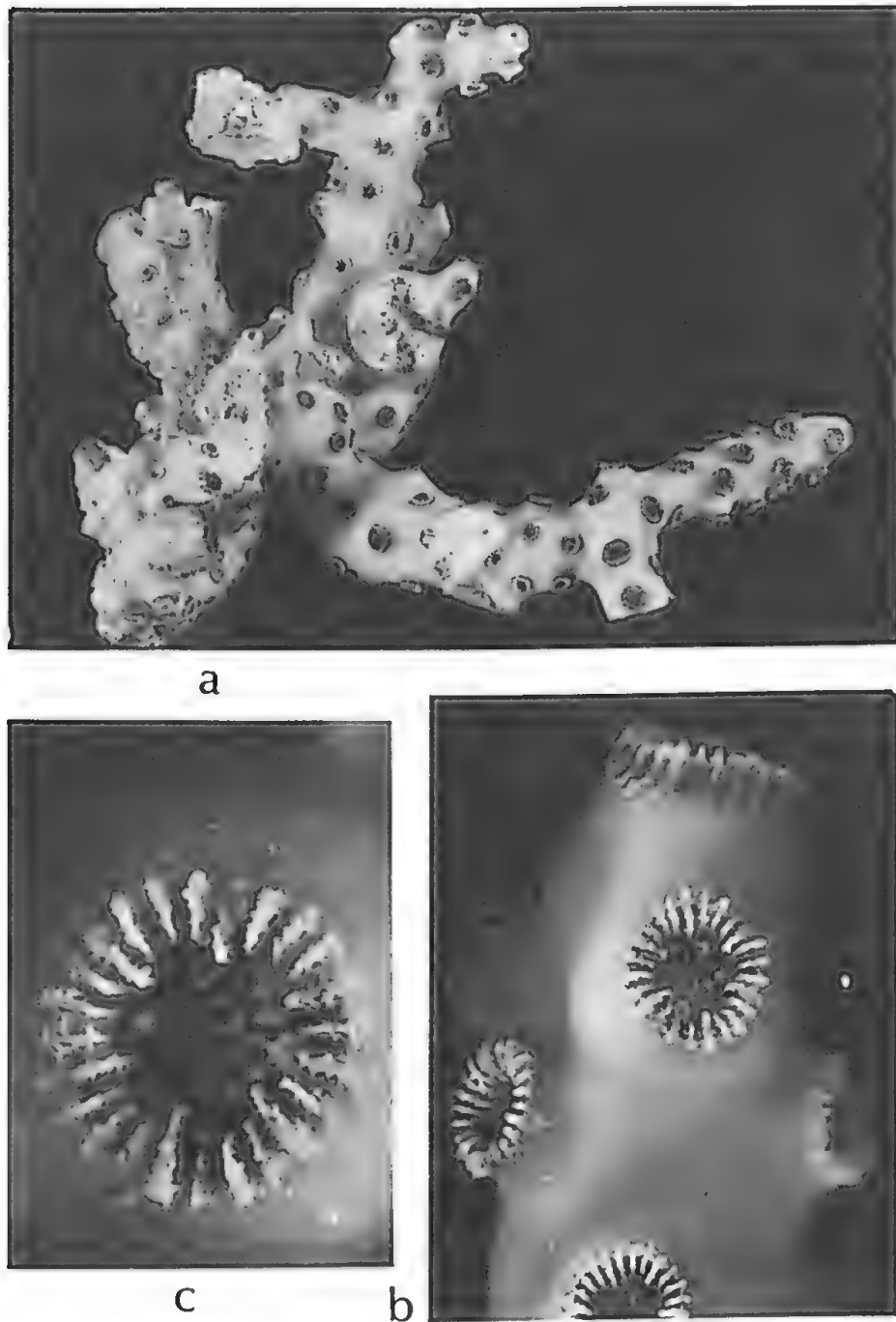


Figure 1

Archohelia rediviva n. sp. Holotype, Queensland Museum G.9834, Rat Island, Queensland.

- a: General aspect, x1.
- b: Tip of branch with large axial corallite and several radial corallites, x6.
- c: Radial calice, x14.

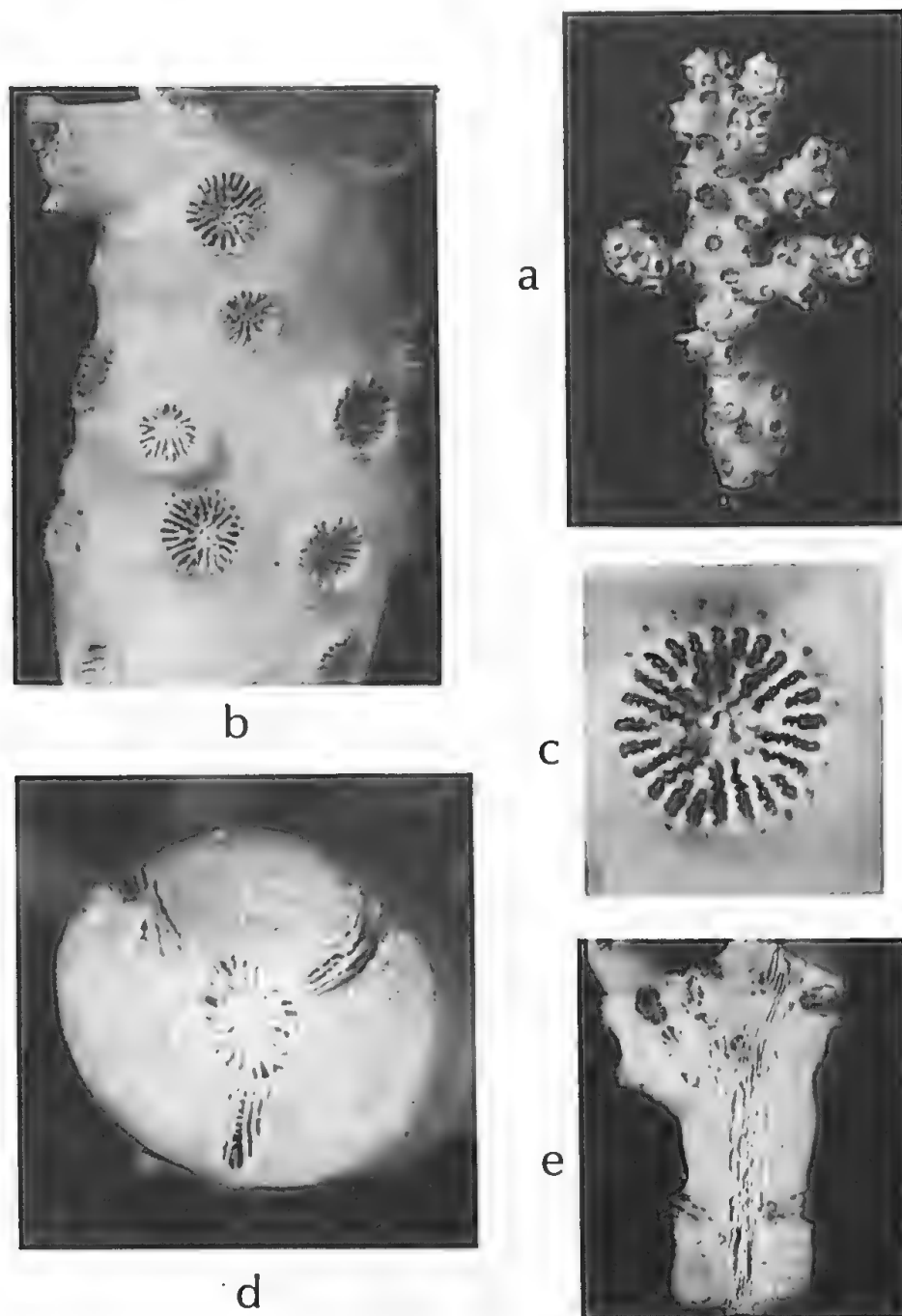


Figure 2

Archohelia rediviva n. sp. Rat Island, Queensland.

a: Branch with branchlets. Paratype, Australian Museum G.14745, x1.

b: Lower part of branch of Figure a, x4.

c: Radial calice at lower part of Figure b, x10.

d: Transverse aspect of main branch of Figure a, showing axial corallite with three radial offsets, x4.

e: Longitudinal section of branch. Paratype, Queensland Museum G.9836, x1.6.

approximately 7 m across, 14 m long and up to 5 m deep at low tide. The rim of this cavity is submerged at high tide. Towards the bottom and rear of this hole, under rocky overhangs, occur the *A. rediviva* colonies, in close proximity to several species of brown algae and numerous sponges. In this position the water currents are possibly reduced and the colonies are afforded considerable protection from direct wave activity during periods of rough weather. Several years ago flourishing stands of a species of *Acropora* grew nearby. A large fresh and/or pollution from the local heavy industry may have contributed to its death, and the skeletons are now encrusted with sponges and algae. This environmental change, resulting in the disappearance of the hermatypic *Acropora* may not have affected the ahermatypic (lacking zooxanthellae) *Archohelia* that survives.

DISCUSSION

While *A. rediviva* is regarded as a new species, comparisons with the older extinct Cenozoic species are difficult. Most fossil species of the genus are based on broken and worn parts of branches. The youngest of these and the type of the genus, *A. limonensis*, is only slightly different from *A. rediviva*, the sole apparent difference being that the tertiary septa of *A. limonensis* are usually free at their inner ends, as they are in the dozen or so older species, whereas they are regularly fused to the six septa of the second cycle in *A. rediviva*.

For the most part, taxonomic studies of corals from this region of Australia have been based on collections from the offshore coral reefs and not from waters close to the mainland. That this new species has not been noted before may therefore indicate that it will be found to be restricted to shallow mainland waters or the rocky islands close to the mainland. As to the provenance of this stranger in Queensland waters, there are no hints from other occurrences of the genus or its very close relative *Oculina* in Australia. Thus far the only record of *Oculina*? or *Archohelia*? sp. is a few fossil fragments from the Tertiary of the Langley Park Bore, Perth (Wells, 1942) (*Oculina fasciculata* Saville Kent from the Great Barrier Reef is an *Echinopora*). The nearest other record of *Oculina* is from the Miocene to Recent in New Zealand (Squires, 1958; Ralph and Squires, 1962; Squires and Keyes, 1967). The next nearest record is *A. limonensis* in the Pliocene of Costa Rica. *Oculina remondi* Philippi from the Miocene (or Pliocene) of Caldera, Chile (Möricke, 1896), poorly known, may be an *Archohelia*. There is some analogy with the mysterious appearance near Savona, Italy, of a thriving colony of *Oculina*, referred to *Oculina patagonica* de Angelis by Zibrowius (1974). This is the only record of this genus in the Mediterranean and it is unknown in the Eastern Atlantic although a relative, *Schizoculina*, occurs uniquely in the Gulf of Guinea. *Oculina patagonica* was previously known only from subrecent strata in Argentina. Zibrowius found no plausible explanation of this erratic occurrence, as inexplicable at present as *Archohelia* living in Australia.

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THE THALASSINIDEA (CRUSTACEA: DECAPODA) OF AUSTRALIA ⁽¹⁾

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SUMMARY

The mud shrimps, ghost shrimps, sponge shrimps, marine yabbies and related animals occurring in Australia are described and illustrated.

The number of Australian species is increased from 22 to 40 species by the addition of 12 new species and of six species not previously recorded from Australia. The 40 species are placed in 10 genera within six of the seven families currently considered to form the tribe Thalassinidea. The fauna is dominated by species of *Callinassa* and *Upogebia* which contain 13 and 11 species respectively.

Of the 40 species only 24 are known from more than 3 localities. The fauna contains a large element of 28 species (of which 12 are new) known only from Australia. Of the remaining 12 species only six have a geographic range extending beyond Indonesia.

The distribution patterns of the species within Australia are similar to those of other families of decapods, the bulk of the species being northern or southern with a few being essentially eastern or western. The northern (tropical) fauna contains those few species with ranges extending beyond Australia.

The fauna is amongst the richest of any area so far studied, although many areas are so far poorly known.

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INTRODUCTION

The tribe Thalassinidea includes loosely built lobster-like crustaceans which burrow in sand or mud or which live in cavities in reefs or in sessile animals such as sponges, corals and so on.

In Australia they are commonly called mud shrimps, ghost shrimps, yabbies, sponge shrimps and probably other more local names.

The tribe is characterized by a reasonably well calcified, compressed carapace; a symmetrical, extended, often feebly calcified abdomen terminating in a well developed tail fan; the chelate or subchelate first pair of legs; chelate, subchelate or simple second legs; and, always, non-chelate third legs (Wear & Yaldwyn, 1966).

The systematic position of the Thalassinidea, the subject of some controversy, is beyond the scope of this study. They have been variously placed as a tribe in the Section Anomura along with the Galatheidea (squat lobsters), Paguridea (hermit crabs) and Hippidea (mole crabs) (Borradaile, 1907; Calman, 1909; Barnard, 1950; Balss, 1957) and more recently as a tribe within the Section Macrura, along with the Homaridea and Palinura (lobsters) (Bouvier, 1940; Zariquiey Alvarez, 1968; Wear & Yaldwyn, 1966). Gurney (1938) discussed the relationships of the Thalassinidea to both groups. In the two most recent classifications of the Decapoda this difference of opinion persists. Waterman & Chace (1960) placed the Thalassinidea in the Section Macrura; Glaessner (1969) placed the superfamily Thalassinidea in the infraorder Anomura.

The Thalassinidea comprise seven families: Callianassidae, Axiidae, Callianideidae, Upogebiidae, Laomediidae, Axianassidae and Thalassinidae (Gurney, 1938; Wear & Yaldwyn, 1966) but these have been reduced to four by inclusion of the Axianassidae in the Laomediidae and the Upogebiidae and Callianideidae as subfamilies of the Callianassidae (Balss, 1957). More recently de Saint Laurent (1973) revived the Upogebiidae, a decision followed by Le Loeuff & Intes (1974), and suggested the Callianideidae may be part of the Axiidae. Until these questions are resolved, we have placed our species in six separate families; *Axianassa* has not been recorded from Australia and we do not consider it further.

The group has received reasonable attention in recent years in South Africa (Barnard, 1950; Kensley, 1974), South America (Holthuis, 1952, 1959; Rodrigues, 1971; De Carvalho & Rodrigues, 1973), North America (Biffar, 1970, 1971a, 1971b; Thistle, 1973; Boesch & Smalley, 1972; Williams, 1974), the Pacific (Edmondson, 1944), Japan (Miyake & Sakai, 1967; Sakai, 1962, 1966, 1967a, 1967b, 1967c, 1968, 1969, 1970a, 1970b, 1970c, 1971), Gulf of Guinea (Bozic & de Saint Laurent, 1972; Le Loeuff & Intes, 1974), East Africa (Sakai, 1975), Pakistan (Tirmizi, 1970), India (Sankolli, 1970-72), the Mediterranean (Bouvier, 1940; de Gaillande & Lagardere, 1966; Holthuis & Gottlieb, 1958; Zariquiey Alvarez, 1968; de Saint Laurent, 1970) and the Gulf of Gascogne (de Saint Laurent, 1972).

In Australia, on the other hand, apart from recent studies on the biology of one species (Hailstone & Stephenson, 1961) and on one of the smaller families (Yaldwyn & Wear, 1970, 1972) there has been no recent treatment of the group. Notes on fossil species have been provided by Campbell & Woods (1970) and on some larval forms by Dakin & Colefax (1940).

The discovery of a number of new species in Port Phillip Bay, Victoria, during the course of a large scale survey of the soft-bottom benthic fauna (Poore, 1975) prompted a review of Australian species of the group. Up to the commencement of these studies a total of 20 species had been described from Australia (Haswell, 1881; Fulton & Grant, 1902, 1906; Baker, 1907; De Man, 1925a, 1925c, 1928a; Hale, 1927, 1941; Ward, 1945; Yaldwyn & Wear, 1970, 1972).

This report deals with all known species from the Australian continent and adjacent islands. Our aim in this work is to describe as fully as possible the Australian thalassinidean fauna and to present diagnoses to aid in the identification of the species. We make few comments on the familial and generic classification of the group which is currently in a state of flux. Collation of material from Australian museums revealed several new species most of which are described here. Some new species recognized by us, notably two species of *Callianassa* from Western Australia and four axiids of doubtful generic status from north-western Australia, have not been included because of the poor condition of the material. The deep burrowing habits of many thalassinideans means that they are poorly represented in many collections, especially deep water samples usually taken by dredge or grab. The paucity of specimens of many species indicates that many more remain to be described from this area. In order to make this account as complete as possible we have described some species from few specimens. The descriptions deal with the principal morphological features of taxonomic importance; however, they are brief and are meant to be used in conjunction with the figures. Most figures have been drawn without setae except where these are taxonomically important. All scales, or divisions of scales, on the figures equal 1 mm. Carapace length is abbreviated as cl. and total length tl. Unless otherwise indicated, new species names are derived from the names of localities near which the species have been collected.

Specimens dealt with come from: The Queensland Museum, Brisbane (QM) including specimens from the University of Queensland, Department of Zoology, benthic survey of Moreton Bay (QUBS); The Australian Museum, Sydney (AM), which includes collections of the Commonwealth Scientific and Industrial Research Organization (CSIRO) Division of Fisheries and Oceanography made for the Gulf of Carpentaria Prawn Survey and in other locations; the National Museum of Victoria, Melbourne (NMV), including collections made by the Victorian Ministry for Conservation, Fisheries and Wildlife Division, in its Crib Point Benthic Survey (CPBS) in Western Port and as part of the Port Phillip Bay Environmental Study (PPBES); the Tasmanian Museum, Hobart (TM); the South Australian Museum, Adelaide (SAM); and the Western Australian Museum, Perth (WAM).

KEY TO AUSTRALIAN THALASSINIDEA

- | | | |
|------|---|------------------|
| 1 | Appendix interna (article or lobe on inner ramus of pleopods 3-5) present, but inconspicuous in Callianassidae (elongate, narrow shrimps with flattened eyestalks and small rostrum — Callianassidae and Callianideidae — or compact shrimps with reflexed abdomen, cylindrical eyestalks and spinose rostrum — most Axiidae) | 2 |
| — | Appendix interna absent (compact shrimps with reflexed abdomen, cylindrical eyestalks, rostrum variously spinose, setose or reduced — Upogebiidae) | 27 |
| 2(1) | Without epipods on pereopods | Callianassidae 3 |
| — | Epipods on pereopods | 17 |

Family Callianassidae

- | | | |
|------|---|------------------------------------|
| 3(2) | Large cheliped cylindrical and pectinate (fixed finger and dactyl armed along their cutting edges with numerous longer and shorter slender pointed teeth) | <i>Ctenocheles collini</i> (p 277) |
| — | Large cheliped laterally flattened and not so armed | 4 |

- 4(3) Propod and dactyl of small cheliped strongly tapering; exopod of uropod distally notched *Gourretia coolibah* (p 278)
- Propod and dactyl of small cheliped not tapering; exopod of uropod not distally notched *Callianassa* 5
- 5(4) Maxilliped 3 with long epipod reaching beyond ischium of exopod; merus of large cheliped with a strong unarmed lobe along entire ventral edge, merus almost as broad as carpus; dactyl of small cheliped twice as long as fixed finger *C. tooradin* (p 275)
- Maxilliped 3 without epipod (or if present minute); merus of cheliped with hooks or complexly dentate but not ventrally lobed, merus narrower than carpus; dactyl and fixed finger of small cheliped subequal 6
- 6(5) Chelipeds subequal (presumed so in *C. bulimba*); rostrum short, obtuse; telson much shorter than uropods 7
- Chelipeds unequal; rostrum short or a spine; telson as long as or shorter than uropods 8
- 7(6) Telson concave posteriorly, widest at midpoint and bearing a transverse ridge; propod of maxilliped 3 unarmed *C. aequimana* (p 245)
- Telson straight posteriorly, widest proximally and without a transverse ridge; propod of maxilliped 3 with small teeth on medial margin *C. bulimba* (p257)
- 8(6) Rostrum, and sometimes lateral projections also, spinose 9
- Neither rostrum nor lateral projections spinose, at most broadly acute but usually obsolete 12
- 9(8) Rostrum and lateral projections spinose 10
- Rostrum only spinose, lateral projections obsolete 11
- 10(9) Telson subovate, widest at midpoint; rostral spine directed anteriorly in line with gastric region; cheliped coxae with a strong medial hook *C. collaroy* (p260)
- Telson tapering, widest proximally; rostral spine directed upwards from slope of gastric region; cheliped coxae without a hook *C. haswelli* (p263)
- 11(9) Large cheliped merus with a single strong ventral hook; uropod endopod ovate, widest in distal half; maxilliped 3 without epipod ... *C. joculatrix* (p266)
- Large cheliped merus denticulate ventrally but lacking a strong hook; uropod endopod lanceolate, widest in proximal half; maxilliped 3 with small epipod *C. karumba* (p266)
- 12(8) Peduncle of antenna 1 twice as long as that of antenna 2, bearing dense rows of long setae ventrally; maxilliped 3 merus strongly expanded distally beyond articulation with carpus *C. australiensis* (p250)
- Peduncles of antennae of similar length, without dense long setae; maxilliped 3 merus not expanded distally 13
- 13(12) Merus of large cheliped with a strong ventral hook, often secondarily dentate 14

- Merus of large cheliped with no ventral hook, finely denticulate 16
- 14(13) Propod of maxilliped 3 almost as long as broad, three times wider than dactyl, lobed ventrally; eyes reduced *C. limosa* (p270)
- Propod of maxilliped 3 much longer than broad, about twice as wide as dactyl, scarcely lobed ventrally; eyes normal 15
- 15(14) Telson subquadrate, shorter than uropod endopod; cheliped merus with at most a denticulate ridge distal to its hook; male pleopod 2 absent *C. arenosa* (p 250)
- Telson tapering slightly distally, as long as uropod endopod; cheliped merus with strongly dentate ridge distal to its hook; male pleopod 2 present *C. ceramica* (p 257)
- 16(13) Telson as long as uropod endopod; maxilliped 3 ischium much broader than long, propod much narrower than ischium *C. amboinensis* (p248)
- Telson shorter than uropod endopod; maxilliped 3 ischium narrower than long, propod as broad as ischium *C. mucronata* (p273)

Family Callianideidae

- 17(2) Pleopods with branchial filaments (numerous articles on the margins of both rami) Callianideidae
- Branchial filaments ovate *Callianidea leura* (p281)
- Pleopods without branchial filaments Axiidae 18

Family Axiidae

- 18(17) Exopod of uropod with transverse suture *Axiopsis* 19
- Exopod of uropod without suture 23
- 19(18) Rostrum extending forward at same level as gastric region; scaphocerite and dorsal spine on article 2 of antenna 2 long; telson without movable spines Subgenus *Axiopsis* 20
- Rostrum arising at lower level than gastric region; scaphocerite and dorsal spine short; telson with movable spines distolaterally Subgenus *Paraxiopsis* 22
- 20(19) Submedian carinae unarmed in gastric region; median carina not extending on to base of rostrum but ending anteriorly as 1-3 teeth *A. werribee* (p232)
- Submedian carinae dentate; median carina extending on to rostrum as a tuberculate ridge 21
- 21(20) Submedian carinae coarsely tuberculate, ending simply anteriorly; anterolateral margin of carapace with an antennal tooth. *A. consobrina* (p230)
- Submedian carina finely tuberculate, recurving anteriorly as a deep U; anterolateral margin of carapace unarmed *A. australiensis* (p226)

- 22(19) Cheliped tuberculate or spinose; rostrum strongly toothed laterally; anterolateral margin of carapace with a small tooth near eye *A. brocki* (p228)
- Cheliped smooth; rostrum simply trilobed, scarcely dentate; anterolateral margin of carapace unarmed *A. appendiculis* (p224)
- 23(18) Anterior region of carapace sloping down steeply; scaphocerite minute *Scytoleptus serripes* (p243)
- Anterior region of carapace continuous with rostrum; scaphocerite and antennal spine prominent *Axius*
Rostrum more or less notched or emarginate anteriorly (often obscurely) Subgenus *Neaxius* 24
- 24(23) Exopod of uropod finely denticulate laterally; ischium and merus of cheliped with only a few denticles 25
- Exopod of uropod strongly spinose laterally; ischium and merus of cheliped strongly spinose ventrally 26
- 25(24) Rostrum strongly spinose, spines of medial lobe distinct from those of lateral lobes; exopod of uropod U-shaped, widest at midpoint; carapace up to 23 mm long *A. plectrorhynchus* (p238)
- Spination of rostrum usually obsolete, if not so spines of lateral lobes of rostrum not distinct from those of medial lobe; exopod of uropod subtriangular, widest distally; carapace not more than 13 mm long *A. waroona* (p240)
- 26(24) Spines laterally along cervical groove; dorsal ridge and spine of antenna 2 bearing 1 medial and 2-5 lateral spines *A. acanthus* (p235)
- Cervical groove smooth; dorsal ridge and spine of antenna 2 unarmed *A. glyptocerus* (p236)

Family Upogebiidae

- 27(1) Without epipods on pereopods Upogebiidae
..... single genus *Upogebia* 28
- With epipods on pereopods 38
- 28(27) Pereopod 1 subchelate, dactyl and fixed finger not equal
..... Subgenus *Upogebia* 29
- Pereopod 1 chelate, dactyl and fixed finger equal or subequal
..... Subgenus *Calliadne* 34
- 29(28) Lateral lobes of rostrum about half as long as medial lobes and separated from it by a deep U 30
- Lateral lobes of rostrum obsolete or at most about 1/8th as long as medial lobe 32
- 30(29) Medial and lateral lobes of rostrum ventrally spinose, dorsally smooth *U. spinifrons* (p305)

- Lobes of rostrum not ventrally spinose, with marginal dorsal spines 31
- 31(30) Anterior margin of carapace with spine beside eye; dorsolateral margins of carapace strongly converging anteriorly *U. neglecta* (p301)
- Anterior margin of carapace without spine; dorsolateral margins of carapace not strongly converging anteriorly *U. simsoni* (p301)
- 32(29) Telson with 2 transverse carinae, more or less parallel-sided *U. dromana* (p295)
- Telson smooth or with 1 transverse carina, more or less tapering 33
- 33(32) Propod of pereopod 1 dorsally spinose, an accessory spine in the gape of the chela; rostrum broadly rounded with 3-4 blunt spines each side; telson smooth *U. giralia* (p297)
- Propod of pereopod 1 dorsally smooth, with no spine in gape of chela; medial lobe of rostrum with 4 spiniform teeth; telson with transverse carinae *U. carinicauda* (p292)
- 34(28) Eyestalks exceeding rostrum; medial and lateral lobes of rostrum separated by a broad concavity *U. tractabilis* (p307)
- Eyestalks not longer than rostrum; rostrum trilobed or with strong tubercles laterally 35
- 35(34) Rostrum without lateral lobes, medial lobe twice as wide as long, with 4 small spines; telson with a barely spinulose transverse ridge *U. darwinii* (p292)
- Rostrum with small lateral lobes, about 0.1 length of medial lobe; telson with spinulose transverse and longitudinal ridges 36
- 36(35) Medial lobe of rostrum broadly curved, with about 12 short, equal, closely spaced spines; distal mesial edge of propod of pereopod 1 with 2 strong spines; posterior margin of telson concave *U. bowerbankii* (p289)
- Medial lobe of rostrum triangular, unevenly spinose; distal mesial edge of propod of pereopod 1 with minute denticles; posterior margin of telson convex 37
- 37(36) Medial lobe of rostrum with 2-3 spines each side; lateral lobes reaching less than halfway towards most posterior spine of medial lobe; merus of pereopod 1 with ventral denticles *U. hexaceras* (p299)
- Medial lobe of rostrum with about 6 tubercles each side; the most posterior tubercle level with end of the lateral lobe; merus of pereopod 1 ventrally smooth *U. australiensis* (p287)

Family Thalassinidae

- 38(27) Both rami of uropod with suture Laomediidae
- First pereopod chelate; peduncles of antennae short *Laomedia* 39
- Rami of uropod without suture Thalassinidae
- Antenna 2 with movable triangular scaphocerite; ventral transverse ridge between pleopods 2-5 medially emarginate, laterally tuberculate..... *Thalassina squamifera* (p285)

Family **Laomediidae**

- 39(38) Anterior edge of carapace with antennal and orbital spines; 3-6 teeth beside terminal rostral tooth *L. healyi* (p284)
- Anterior edge of carapace without spines; 1 small tooth beside terminal rostral tooth *Laomedia* "n.s.p." Yaldwyn & Wear, 1972 (p284)

SYSTEMATIC ACCOUNT

Family **Axiidae** Borradaile, 1903**Axiopsis** Borradaile, 1903

REMARKS: We cannot at this stage present a diagnosis for this genus. It has been noted by others (Boesch & Smalley, 1972; Miyake & Sakai, 1967; Williams, 1974; de Saint Laurent, 1972) that the genera of the Axiidae require redefinition. In particular, there is a poor separation between *Axiopsis*, *Calocaris* and *Calastacus* used as subgenera by De Man (1925a). Characters separating the last two, elevated to generic rank, were tabulated by de Saint Laurent (1972) but the status of *Axiopsis* is still unclear. All the Australian species dealt with here key out clearly through De Man's (1925a) key to *Axiopsis*, that is, none possess a dorsal carina running the length of the carapace.

We use *Axiopsis* here for species with a spinose rostrum, a transverse suture on the uropod exopod, and pleopods 2-5 similar. The subgenus *Axiopsis*, characterized by a long scaphocerite and dorsal spine on antenna 2 and continuous gastric region and rostrum, is represented by *A. australiensis*, *A. consobrina* and *A. werribee*; the subgenus *Paraxiopsis*, in which the spines are reduced and the gastric region and rostrum not continuous, by *A. appendiculis* and *A. brocki*.

Axiopsis (Paraxiopsis) appendiculis n. sp.

Fig. 1

MATERIAL EXAMINED: 18 females, 16 males; cl. 7-17 mm.

HOLOTYPE: AM P.9359, female cl. 14 mm.

TYPE LOCALITY. *New South Wales*: Shellharbour, under stones between tide marks, coll. G. McAndrew, 1926.

PARATYPES. *New South Wales*: Minnie Waters, Grafton (AM P.24674) 1 spec.; (AM P.24687) 1 spec. — Long Reef, Collaroy (AM P.9063) 1 spec.; (AM P.9365) 1 spec.; (AM P.18557) 1 spec.; (AM P.7474) 2 specs.; (AM P.8624) 1 spec.; (AM P.24688) 6 specs. — Port Jackson (AM P.8694) 1 spec.; (AM P.15037) 3 specs.; (AM P.265) 5 specs. — Watsons Bay, Port Jackson (AM P.5768) 1 spec.; (AM P.1511-4) 4 specs. — Bottle and Glass Rocks, Port Jackson (AM P.24673) 1 spec. — Camp Cove, Port Jackson (AM P.21116) 1 spec. — Bass Point (AM P.24672) 1 spec. — Shellharbour (AM P.20827) 2 specs.

DESCRIPTION: Rostrum trilobed, median lobe narrow, upturned, blunt, about twice as long as width at base, 0-3 small teeth on lateral margin; lateral lobes $\frac{1}{3}$ length of median lobe. Gastric region falling steeply to rostrum. Five carinae on anterior half of carapace; median carina ending anteriorly just beyond base of rostrum, bearing a tooth midway along; a pair of submedian carinae ending anteriorly as blunt projections at level of tooth of median carina; lateral carinae shorter, arising halfway along submedian carinae, unarmed, running to lateral lobes of rostrum; anterolateral margin of carapace smooth. Antenna 1 peduncle reaching to halfway along article 4 of antenna 2, stylocerite a bluntly

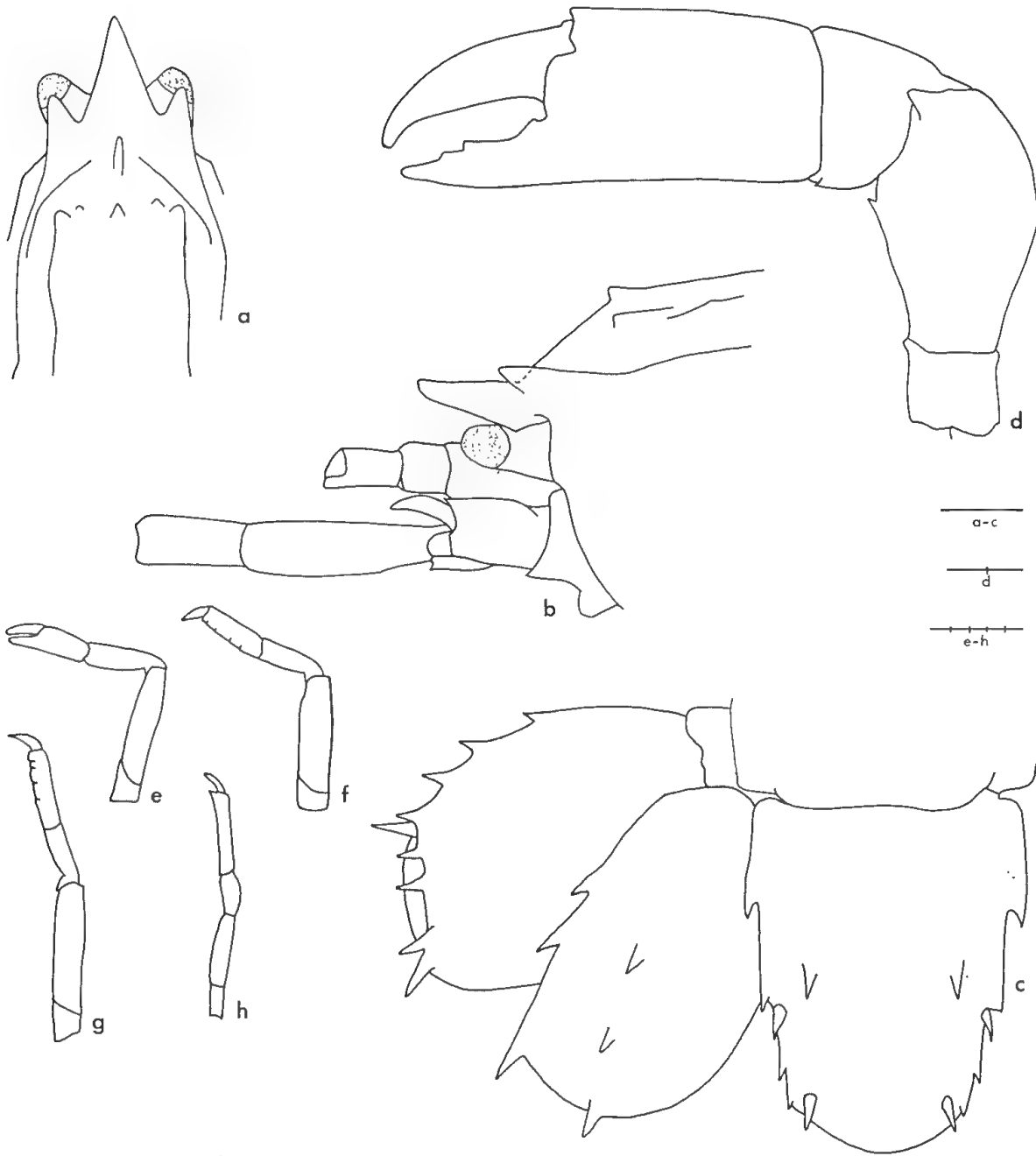


Fig. 1. *Axiopsis appendiculis* (AM P.9359, female, 13 mm): a, b, dorsal and lateral views of anterior region; c, telson and uropod; d, cheliped; e-h, pereopods 2-5.

ended ridge. Antenna 2 article 2 dorsally carinate with a small distal spine; scaphocerite a curved spine $\frac{1}{4}$ as long as article 4; article 3 with a ventral spine. Eyestalks about half length of rostrum. Maxilliped 3 ischium with a mesial toothed ridge; merus with 2 large medial spines; carpus with a small lateral spine on distal edge; propod unarmed. Chelipeds unequal but similar, not sexually dimorphic, extremely robust. Cheliped coxa and ischium smooth; merus inflated with a ventral spine and a flat triangular projection laterally at suture with carpus; carpus with a ventral spine; propod unarmed, dorsally and ventrally pubescent; fixed finger with 1-2 broad blunt teeth on distal half of cutting edge; dactyl as long as fixed finger, with a strong curved tip, its cutting edge with a proximal tooth, otherwise minutely dentate; ratio of dorsal lengths — merus: carpus: propod — 1:0.5:1. Pereopods 2-5 smooth. Pleopod 1 (female) uniramous, the multiarticulate flagellum about twice as long as the first article. Pleopod 1 (male) absent. Telson longer than wide, narrowing slightly distally, lateral margins with 2-4 fixed spines and 2 movable spines, one near base of second fixed spine and one distally; posterior margin semicircular, unarmed; 4 spines in a curved row about midway along dorsal surface. Uropod endopod lateral margin ending in a spine, with 2 spines in distal half, posterior and medial margins continuous, dorsal longitudinal ridge with 3-4 spines, the last on the margin; exopod 2-articulate, lateral margin of first article with 4-5 spines, ending in a long movable spine, 3 spines on lateral dorsal longitudinal ridge, medial ridge terminating in a bifid spine; 2 other spines on distal margin; second article 0.1 total length of exopod.

DISTRIBUTION: Intertidal to 5 m; central New South Wales.

REMARKS: *Axiopsis appendiculis* is similar to *A. brocki*, a species from north and western Australia, with which it shares a short scaphocerite and dorsal spine on antenna 2, and sloping anterior carapace. It differs most noticeably in possessing a trilobed rostrum instead of the strongly spinose lateral carinae characteristic of *A. brocki*. The chelipeds of *A. appendiculis* are smooth, but tuberculate or spinose in *A. brocki*.

This species was first recognized by Dr. T. Hailstone in collections in the Australian Museum in about 1964. We are very grateful to Dr. Hailstone for allowing us to use the MS name he gave it then. The species name was suggested by Dr. Hailstone because of "the presence of an appendix interna on each endopodite of pleopods 2-4" (pers. comm.).

***Axiopsis (Axiopsis) australiensis* De Man**

Fig. 2.

Axiopsis australiensis De Man, 1925c: 127-132, fig. 4 (type locality: Port Jackson); 1925a: 5, 69.

MATERIAL EXAMINED: 32 males, 33 females; cl. 7-22 mm.

New South Wales: Angourie, Clarence R. (AM P.11360) 1 spec. — Woody Head, Clarence R. (AM P.24676) 1 spec. — Long Reef, Collaroy (AM P.15034) 3 specs; (AM P.15035) 1 spec.; (AM P.8623) 1 spec.; (AM P.13164) 1 spec.; (AM P.24675) 3 specs; (AM P.24697) 3 specs; (AM P.24698) 1 spec.; (AM P.24699) 2 specs; (AM P.13184) 2 specs; (AM P.20825) 1 spec.; (AM P.20826) 2 specs; (AM P.7472) 3 specs. — Bottle and Glass Rocks, Port Jackson (AM P.8618) 1 spec.; (AM P.9228) 1 spec. — Watsons Bay, Port Jackson (AM P.15036) 3 specs. — North Head, Sydney (AM P.24689) 1 spec. — Shellharbour (AM P.6310) 2 specs; (AM P.7167,8) 2 specs; (AM P.7239) 8 specs; (AM P.7954) 2 specs; (AM P.9360) 4 specs; (AM P.7414) 6 specs; (AM P.8439) 2 specs; (AM P.7900) 1 spec.; (AM P.9334) 5 specs.

Victoria: Shoreham (AM P.1757) 2 specs.

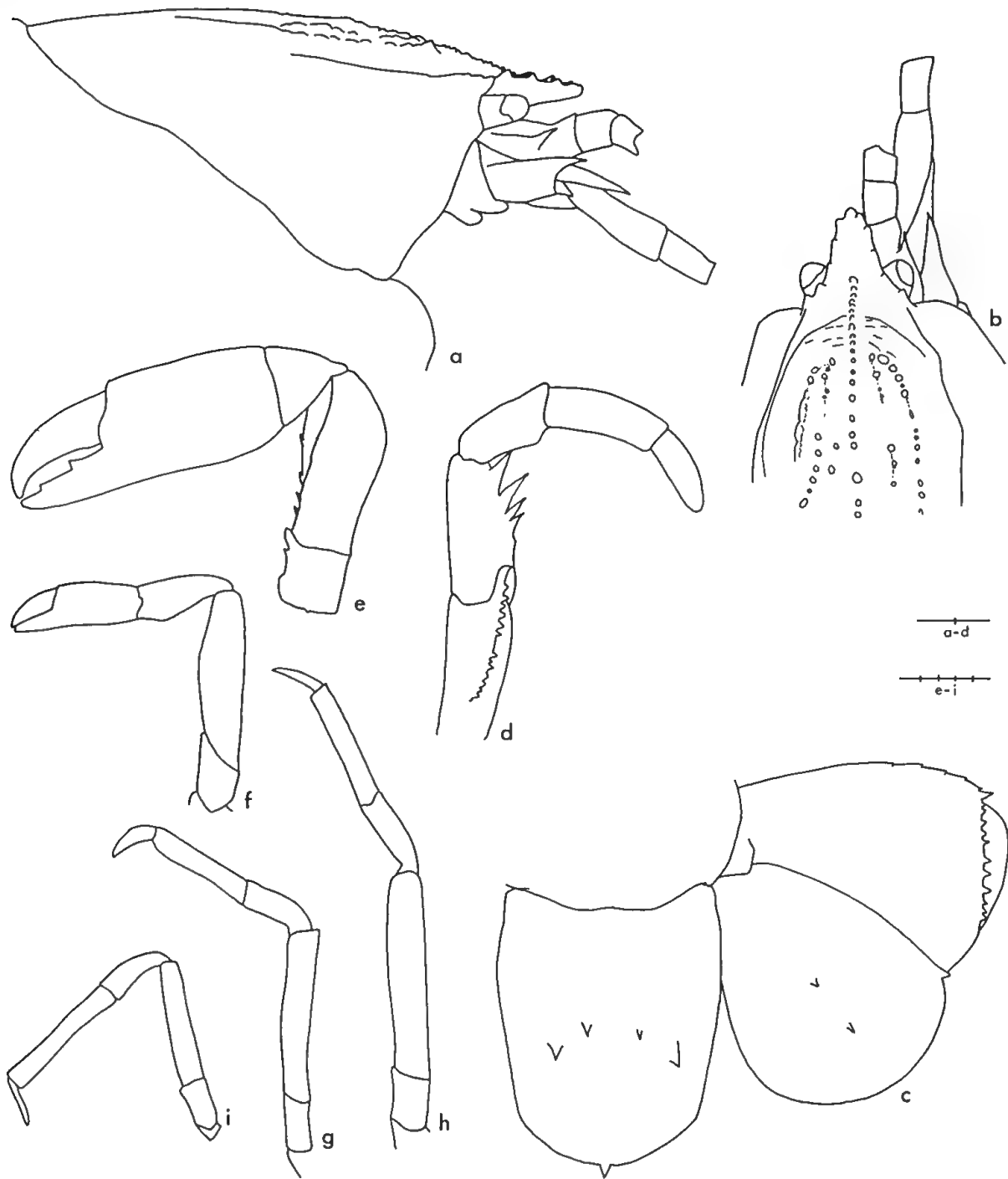


Fig. 2. *Axiopsis australiensis* (AM P.7954, female, 23 mm): a, b, dorsal and lateral views of anterior region; c, telson and uropod; d, maxilliped 3 endopod; e, cheliped; f-i, pereopods 2-5.

DESCRIPTION: Rostrum moderately weakly upturned, blunt, slightly longer than basal width, lateral edges of rostrum bearing 5-6 upwardly directed blunt spines on each side. Gastric region with 2 longitudinal submedian tuberculate ridges, curving together anteriorly about midway along tuberculate median carina to form a deep inverted U; median carina continuing to base of rostrum; posterior part of gastric region smooth; anterolateral margin of carapace smooth. Antenna 1 peduncle reaching to middle of article 4 of antenna 2, stylocerite a strong spine. Antenna 2 article 2 with a distolateral spine; scaphocerite a single long spine reaching to about midpoint of article 4; article 3 smooth. Eyestalks half length of rostrum. Maxilliped 3 ischium with a mesial ridge of strong teeth, merus with 3-4 large medial spines distally. Chelipeds subequal, not sexually dimorphic. Cheliped ischium with dentate ventral edge; merus with ventral dentate ridge laterally and 4-5 strong spines medially, smooth dorsally; carpus and propod smooth; fixed finger cutting edge with a strong tooth at proximal third and another near end; dactyl as long as fixed finger, strong curved tip, cutting edge with a low projection proximally; ratio of dorsal lengths — merus: carpus: propod — 1:0.5:1. Pereopods 2-5 unarmed. Pleopod 1 (female) uniramous, the multiarticulate flagellum about twice as long as the first article. Pleopod 1 (male) absent. Telson longer than wide, lateral margins tapering; posterior margin convex with a short medial spine; surface with 2 pairs of spines centrally, medial pair further forward than lateral pair. Uropod endopod lateral margin ending in a small spine, sometimes bearing 1-2 additional spines, posterior and medial margins continuous, dorsal longitudinal ridge with 3-4 spines; exopod 2-articulate, lateral margin of first article with 3-4 small spines; 2 dorsal longitudinal ridges, 3-4 spines on lateral ridge, medial ridge smooth, 9-10 spines along distal margin; second article 0.1 total length of exopod.

DISTRIBUTION: Intertidal; central New South Wales and central Victoria.

REMARKS: De Man's (1925c) figures adequately characterized this species which is distinguished particularly by the low recurved, beaded submedian carinae on the carapace.

***Axiopsis (Paraxiopsis) brocki* (De Man)**

Fig. 3

Axiopsis Brocki De Man, 1887: 475-480, pl. 20 fig. 3 (type locality: Indonesia — Ambon and near Jakarta).

Axiopsis (Paraxiopsis) Brocki. — De Man, 1905: 597; 1925a: 7, 71, 101-109, pl. 8 fig. 19.

MATERIAL EX(AMINED: 13 males, 6 females; cl. 13-17 mm.

Northern Territory: Waigait Reef, Darwin (AM P. 20357) 1 spec. — Rail Pier, Darwin (AM P.6824) 1 spec.

Western Australia: Burns Beach, Broome (WAM 16-75) 2 specs. — Point Peron (WAM 8-75) 1 spec. — near Geraldton (WAM 18-75) 1 spec. — Mullaloo Beach (WAM 77-75) 1 spec. — Rottnest Is. (WAM 50-75) 1 spec.; (WAM 1047-32) 1 spec.; (WAM 34-75) 1 spec. — Cockburn Sound, near Fremantle (WAM 36-75) 1 spec. — Garden Is. (WAM 24-75) 1 spec.; (WAM 9014) 2 specs; (WAM 8751) 3 specs. — Safety Bay (WAM 68-75) 1 spec. — Augusta (WAM 110-49) 1 spec.

DESCRIPTION: Rostrum narrow, upturned, acute, about 3 times a long as width at base. Gastric region falling gradually down to rostrum, sometimes rugose anteriorly; median carina ending anteriorly at base of rostrum; a pair of submedian carinae ending anteriorly variously as a blunt or rounded projection or as a spine; and lateral carinae running as strongly spinose ridges on to sides of rostrum, 4-6 spines on each side, anterior

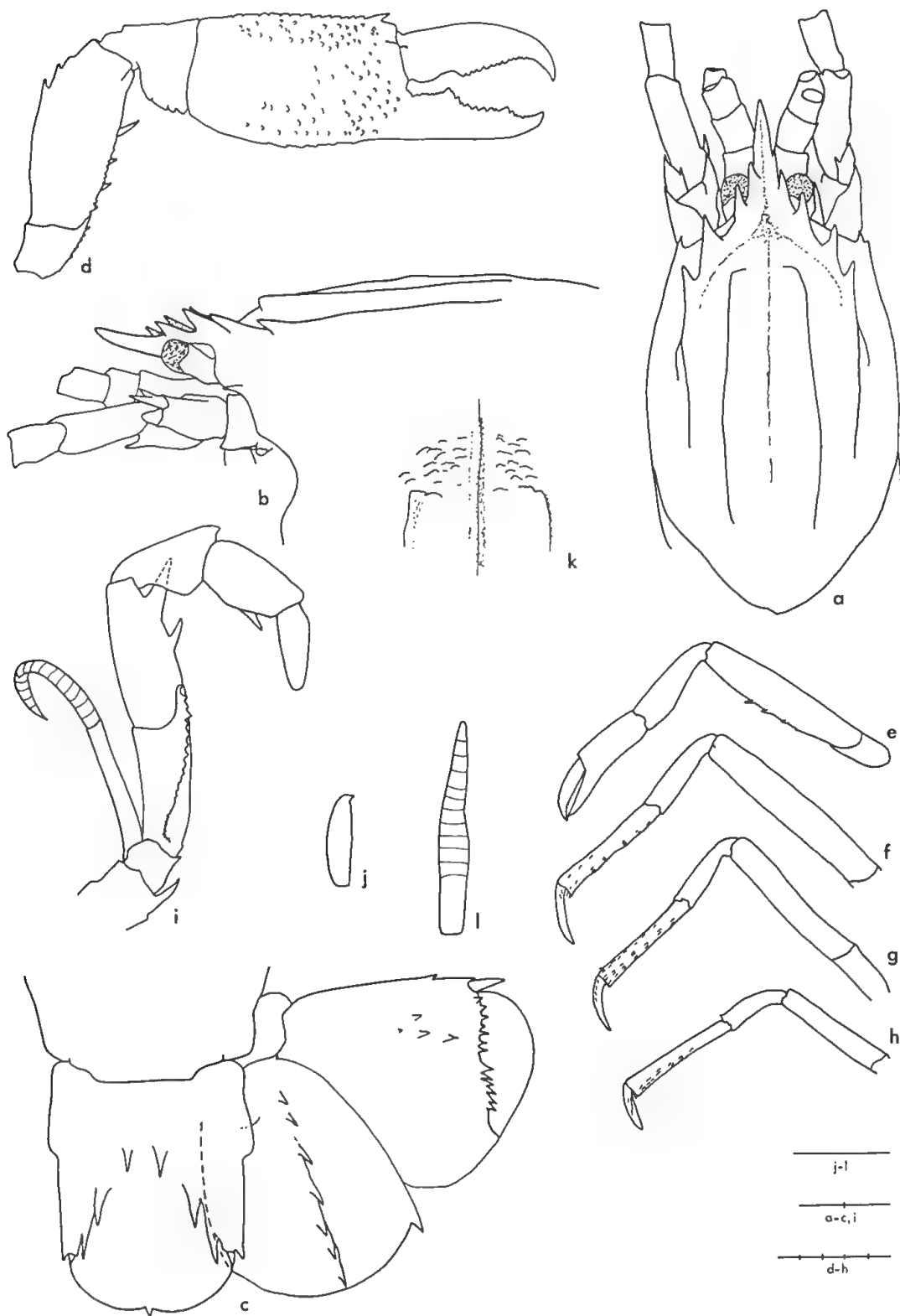


Fig. 3. *Axiopsis brocki* (WAM 24-75, male, 17 mm): a, b, dorsal and lateral views of anterior region; c, telson and uropod; d-h, pereopods 1-5; i, maxilliped 3; j, pleopod 1. (WAM 16-75, female, 17 mm): k, gastric region of carapace; l, pleopod 1.

ones often asymmetrical; anterolateral margin of carapace with a strong spine just above antenna 2. Antenna 1 peduncle reaching to end of article 4 of antenna 2, stylocerite a small spine. Antenna 2 article 2 with a distolateral spine; scaphocerite a double-spined plate, stronger spine laterally; article 3 with a ventral spine. Eyestalks less than half length of rostrum. Maxilliped 3 ischium with a mesial toothed ridge, merus with 2-3 large medial spines plus several smaller spines, propod with a medial spine. Chelipeds subequal, not sexually dimorphic. Cheliped coxa minutely spinose; ischium ventrally spinose; merus with dentate ventral margin and 4-7 submarginal spines, 2-4 dorsal spines distally; carpus and propod tuberculate on ventral, lateral, dorsal and most of medial surfaces; propod with a dorsal spine distally; fixed finger cutting edge strongly dentate, a very strong tooth $\frac{1}{3}$ way along and often a less prominent one about $\frac{3}{4}$ way along; dactyl as long as fixed finger, strong curved tip, cutting edge concave proximally, ratio of dorsal lengths — merus: carpus: propod — 1:0.5:1. Pereopod 2 ischium spinose ventrally, pereopods 3-5 with numerous small articulating spines on propod and dactyl. Pleopod 1 (female) uniramous, the multiarticulate flagellum about 3 times as long as the first article. Pleopod 1 (male) a single small ovate article with a minute terminal hook. Telson longer than wide, parallel-sided but abruptly narrowed $\frac{1}{3}$ way from base, lateral margins with 0-2 spines along length and ending posteriorly in 1 fixed and 1 (sometimes 2) movable spines; posterior margin semicircular with a short medial spine; 2 dorsal diagonal ridges with 3-4 strong spines running down to articulating spines. Uropod endopod lateral margin ending in a small spine, sometimes with 1-4 spines, posterior and medial margins continuous, dorsal longitudinal ridge with 5-8 spines; exopod 2-articulate, lateral margin of first article with 1-2 small spines, ending in a long articulating spine, 3-4 spines on dorsal longitudinal ridges, 13-20 spines along distal margin; second article 0.2 total length of exopod.

DISTRIBUTION: Intertidal to shallow reef; various localities in Indonesia (De Man, 1925a), Northern Territory and Western Australia. The present specimens represent the first records from Australia.

REMARKS: Our specimens agree in general with De Man's description and figures but the submedian carina on the carapace was never found to be interrupted as occasionally noted by De Man nor was its anterior end ever toothed. One incomplete specimen from Cockatoo Island, Western Australia, (WAM 29-75) closely resembled this species but differed in having 5-6 spines in place of the submedian carinae. We are unsure of the systematic position of this specimen.

The species is characterized by the reduced scaphocerite and antennal spine (characteristic of species of subgenus *Paraxiopsis*) and by the complex ornamentation of the telson.

***Axiopsis (Axiopsis) consobrina* De Man**

Fig. 4.

Axiopsis consobrina De Man, 1905: 595-596 (type localities: Philippine Is. — Sulu Archipelago; Indonesia — Buton Strait and Solor Strait); 1925a: 5, 69, 80-84, fig. 13.

MATERIAL EXAMINED: 1 male, 1 female; cl. 19, 24 mm.

Queensland: Gulf of Carpentaria, CSIRO stn 363 (AM P.16308) 1 spec.; CSIRO stn 557 (AM P.24677) 1 spec.

DESCRIPTION: Rostrum narrow, downwardly deflexed, acute, almost twice as long as width at base, about 7 spines on each edge, tip of rostrum horizontal. Gastric region falling very gradually down to rostrum; 5 longitudinal, spinose carinae arising near cervical

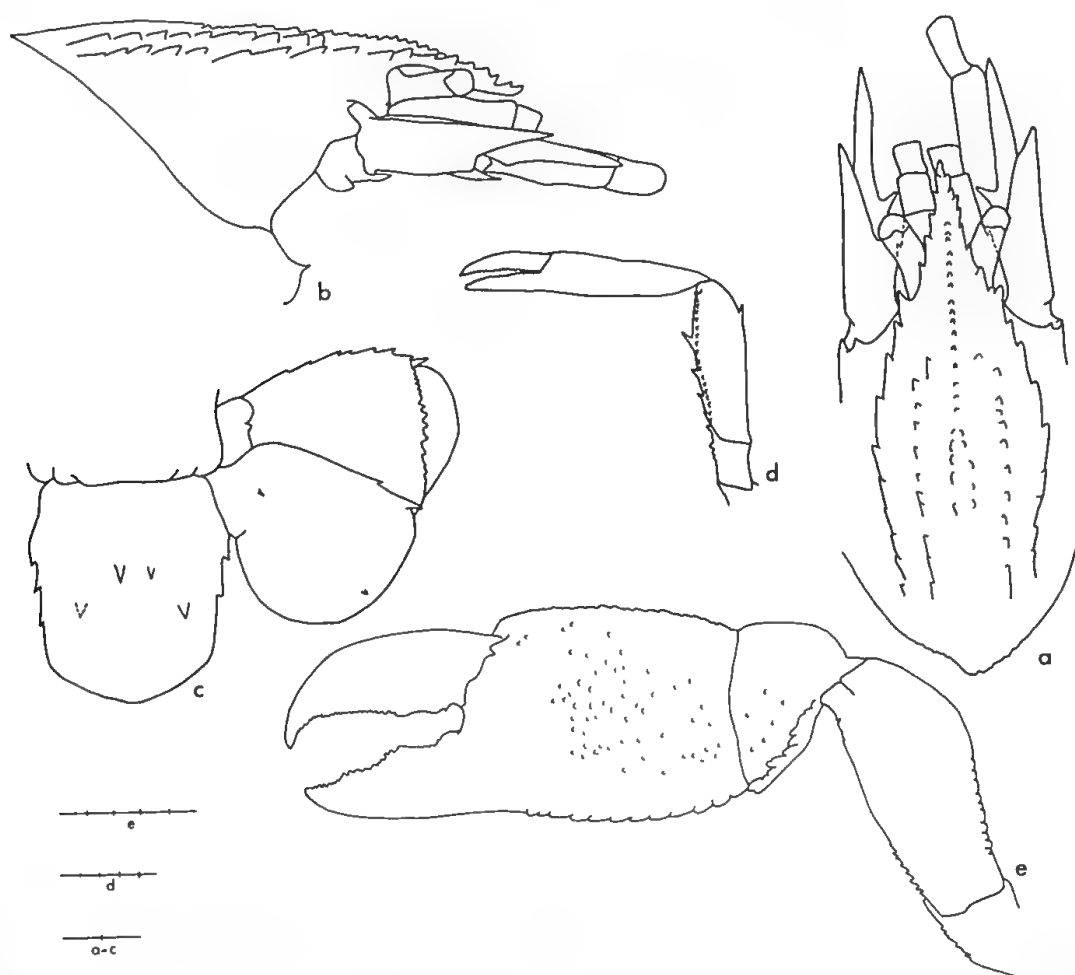


Fig. 4. *Axiopsis consobrina* (AM P.16308, male, 19 mm): a, b, dorsal and lateral views of anterior region; c, telson and uropod; d, small cheliped. (AM P.24677, female, 24 mm): e, pereopod 1.

groove; median carina extending forwards halfway along rostrum, existing as a double row of spines in part of posterior third; a pair of submedian carinae extending anteriorly to just over halfway along median carina; and lateral carinae running on to sides of rostrum; anterolateral margin of carapace with a small spine just above antenna 2. Antenna 1 peduncle reaching to proximal third of article 4 of antenna 2, stylocerite a small spine. Antenna 2 article 2 with a strong dorsal ridge and spine; scaphocerite a strong spine as long as or nearly as long as article 4 and bearing a basal medial spine; article 3 with a ventral spine. Eyestalks slender, half length of rostrum. Maxilliped 3 ischium with a mesial toothed ridge; merus with 4 medial spines, increasing in length distally; propod unarmed. Chelipeds unequal. Large cheliped coxa without spines; ischium spinose ventrally; merus with 4 ventral spines, its ventro- and dorsolateral edges dentate; carpus with a smooth dorsal ridge and dentate ventral ridge; propod with serrate dorsal and ventral ridges, surfaces minutely spinose, cutting edges of fingers dentate; dactyl as long as fixed finger; ratio of dorsal lengths — merus: carpus: propod — 1:0.3:0.8. Small cheliped similar to other but more slender and with a strong dorsal spine on the merus. Pereopod 2 ischium and merus spinose ventrally, pereopods 2-4 meri ventrally spinose. Pleopod 1 (female) uniramous, 2-articulate, second article bluntly lanceolate. Pleopod 1 (male) a single small ovate article with a minute terminal hook. Telson and uropods terminally setose. Telson

longer than wide, almost parallel-sided, lateral margins with 2 or 3 spines; posterior margin semicircular, with a median spine; a pair of submedial spines on dorsal surface at proximal third and 2 larger spines closer to edges halfway along. Uropod endopod lateral margin with a terminal spine and sometimes others, posterior and medial margins continuous, dorsal longitudinal ridge with 5 spines; exopod 2-articulate, lateral margin of first article with 5-7 small spines, dorsal longitudinal ridge sometimes spinose, 1 articulating plus 12 fixed spines along distal margin; second article 0.2 total length of exopod.

DISTRIBUTION: Shallow reef down to 27 m; various localities in Indonesia (De Man, 1925a), northern Queensland. The present specimens represent the first records from Australia.

REMARKS: De Man (1925a) figured and described this species well and our specimens agree with his remarks. This species is one of a number of thalassinideans previously known from Indonesian islands which have now been discovered in north Australian waters. The species is related to *A. serratifrons* known throughout the Pacific (De Man, 1925a).

***Axiopsis (Axiopsis) werribee* n. sp.**

Figs 5, 6

MATERIAL EXAMINED: 38 specs.; tl. 11-29 mm.

HOLOTYPE: NMV J.280, female, tl. 29 mm.

TYPE LOCALITY: *Victoria*: 15 km E. of St Leonards, Port Phillip Bay (PPBES stn 956); clay sediment; 24 m; 14th February, 1970.

PARATYPES: *Victoria*: Port Phillip Bay PPBES stn 909 (NMV J.281) 1 spec.; stn 911 (NMV J.282) 1 spec., (AM P.25276) 1 spec.; stn 917 (NMV J.283) 2 specs, (AM P.25277,8) 4 specs; stn 923 (NMV J.284) 1 spec.; stn 925 (NMV J.285) 1 spec.; stn 930 (NMV J.286) 1 spec.; stn 931 (NMV J.287) 1 spec., (AM P.25279,80) 3 specs; stn 932 (NMV J.288) 1 spec.; stn 933 (NMV J.289) 1 spec.; stn 936 (NMV J.290) 1 spec., (AM P.25281) 1 spec.; stn 937 (NMV J.291) 1 spec.; stn 938 (NMV J.292) 1 spec., (AM P.25282,3) 2 specs; stn 949 (NMV J.293) 1 spec.; stn 954 (NMV J.294) 1 spec., (AM P.25284) 1 spec.; stn 956 (NMV J.295) 1 spec.; stn 957 (NMV J.296) 1 spec.; stn 969 (NMV J.297) 2 specs, (AM P.25285) 1 spec.; stn 976 (NMV J.298) 1 spec.; stn 977 (NMV J.299) 1 spec.; stn 983 (NMV J.300) 1 spec., (AM P.25286) 1 spec.

OTHER MATERIAL: *Tasmania*: Isthmus Bay, Bruny Is. (J. Lim colln).

DESCRIPTION: Rostrum evenly tapering to a terminal, upturned point, laterally 4-6 asymmetrically placed teeth; median dorsal carina ending anteriorly at base of rostrum as 1-3 strong teeth; 2 pairs of low submedian carinae without teeth. Antenna 1 peduncle as long as first 4 articles of antenna 2, with a dorsolateral spine on distal margin of article 1. Antenna 2 with 1 ventral and 2 short medial spines on distal margin of article 1, a strong dorsal ridge and spine on article 2, a ventral spine on distal margin of article 3, scaphocerite shorter than article 4 and with a mesial spine proximally. Eyestalks about half length of rostrum. Maxilliped 3 ischium with pronounced curved toothed ridge on mesial surface; merus about as long as ischium with 3-5 medial spines. Chelipeds unequal, not sexually dimorphic. Large cheliped coxa with 2 ventral spines; ischium with 0-4 (usually 1) minute ventral teeth; merus with 4-6 hooked teeth ventrally and sometimes 1 dorsally; propod 0.7 times as wide as long, often with 1 distal dorsal tooth and sometimes 1-2 minute ventral teeth; fixed finger cutting edge variable, usually with a tooth or serrate blade at the midpoint; dactyl curved, ridged laterally; ratio of dorsal lengths — merus: carpus: propod — 1: 0.5: 0.6-1.2. Small cheliped with similar arrangement of spines as large cheliped, fixed

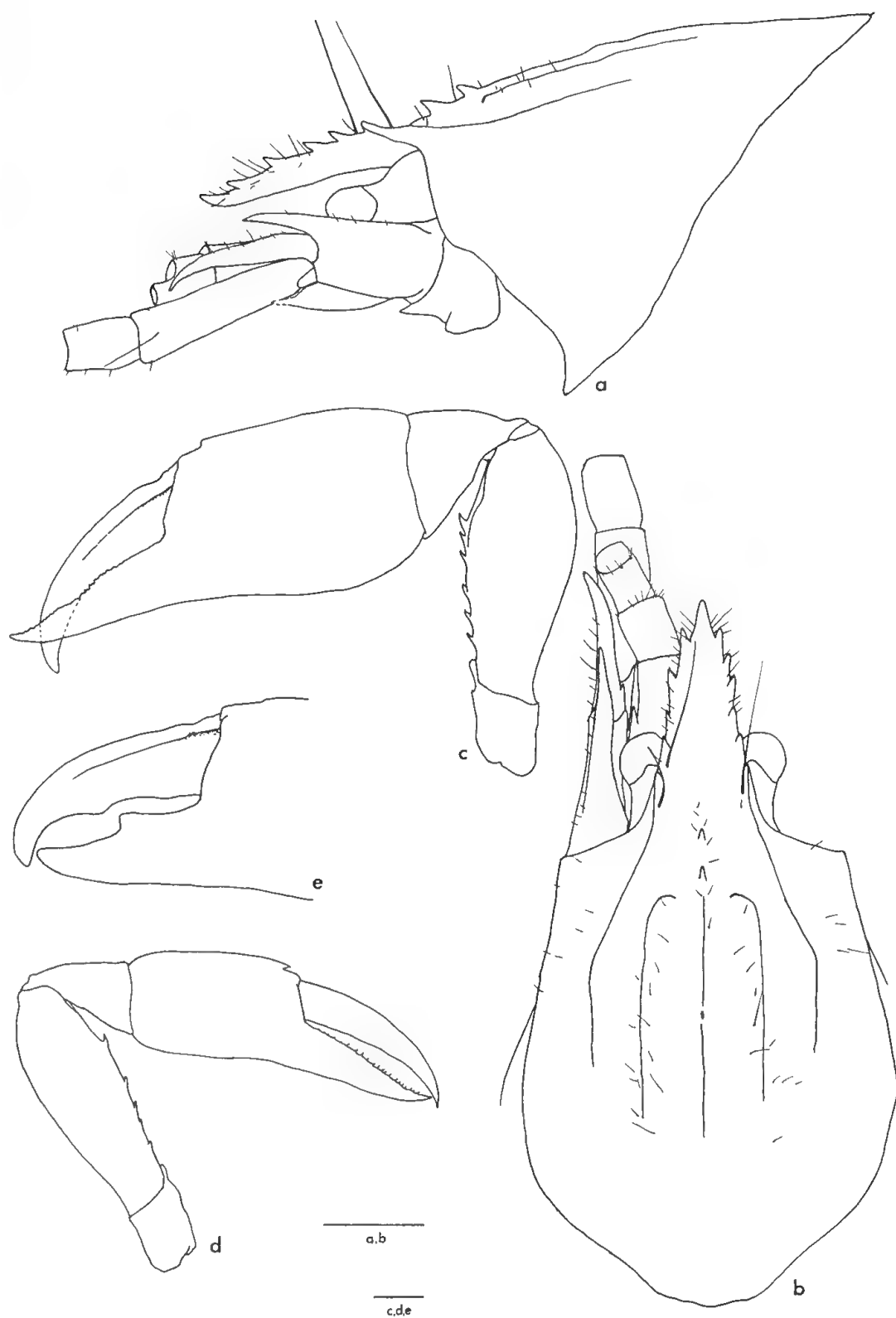


Fig. 5. *Axiopsis werribee* (NMV J.280, female, 21 mm): a, b, dorsal and lateral views of anterior region; c, large cheliped; d, small cheliped. (NMV J.298, female, 24 mm): e, large cheliped.

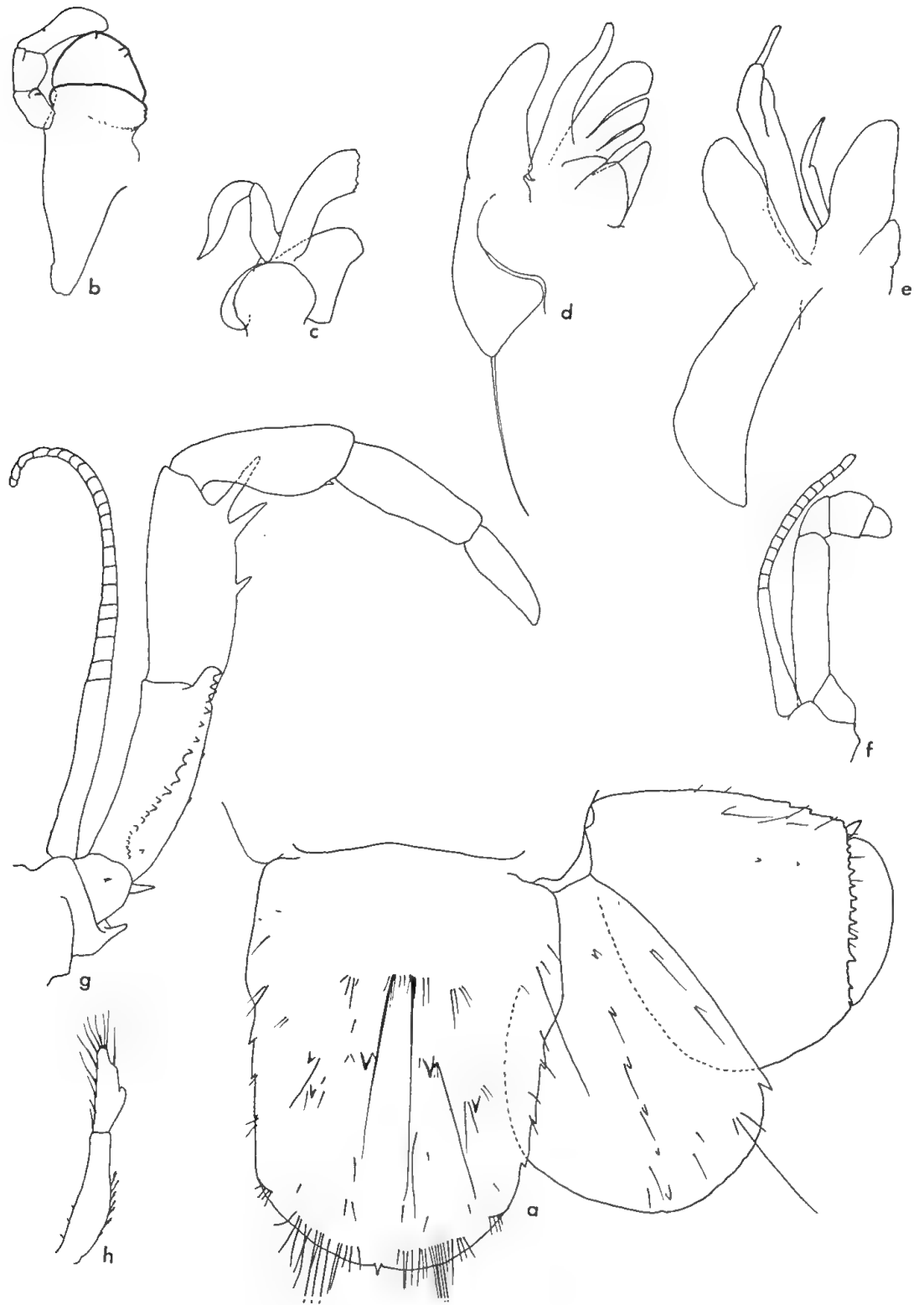


Fig. 6. *Axiopsis werribee* (NMV J.280, female, 21 mm): a, telson and uropod; b, mandible; c, d, maxillae 1, 2; e-g, maxillipeds 1-3; h, pleopod 1.

finger cutting edge with many fine erect teeth. Pereopod 2 coxa with ventral hook; pereopods 3-5 unarmed. Pleopod 1 (female) uniramous, 2-articulate, second article smaller, medially lobed. Pleopod 1 (male) absent. Telson longer than broad, with at least 2 pairs of dorsal spines and 1-3 lateral spines. Uropod endopod shorter than telson, a strong laterodistal spine and a spinose median rib; exopod first article with medial margin strongly convex, lateral margin serrate; row of minute spines on dorsal surface, articulating spine on laterodistal corner; distal edge spinose; second article about 0.15 total length of exopod.

DISTRIBUTION: Clay sediments 10-25 m; Victoria (Port Phillip Bay), Tasmania.

REMARKS: *Axiopsis werribee* is a small species with restricted distribution. It shares with *A. spinulicauda* Rathbun from the northwest coast of North America an absence of dorsal spines except on the median carina, a feature not common in the genus.

This species is described from quantitative benthic samples from the PPBES (Poore, 1975). Smith-McIntyre grab samples (0.1 m²) indicate a mean density at stations where it was taken of 3.6 individuals per square metre, with highest densities and a maximum of 12 per square metre on the coarsest (sandy-silt) sediments of its range.

***Axius* Leach, 1815**

REMARKS: A modern clear diagnosis has not been presented for this genus but among Australian axiids, species of *Axius* are recognized by both rami of the uropods being of one article, cylindrical eyestalks and the gastric region not falling steeply to the rostrum. De Man (1925a) recognized two subgenera: *Axius* with pleurobranches on pereopods 2-4 and a pointed rostrum, and *Neaxius* lacking pleurobranches on pereopods 2-4 and with a terminally notched rostrum. The four Australian species listed here fall within the subgenus *Neaxius* but in *A. plectrorhynchus* and *A. waroona* the terminal notch on the rostrum is often obscure.

***Axius* (*Neaxius*) *acanthus* A. Milne-Edwards**

Fig. 7.

Axia acantha A. Milne-Edwards, 1879: 110 (type locality: New Caledonia).

Eiconaxius acanthus. — De Man, 1896: 491-497; 1898: pl. 34 figs 57, 57a.

Axius acanthus. — De Man, 1925a: 3, 14; 1925b: 50-56.

Axius acanthus var. *mauritanus* Bouvier, 1915: 196-198, fig. 7. — Fourmanoir, 1955: 31, fig. 4.

MATERIAL EXAMINED: 2 specimens, both without abdomens.

Queensland: Murray Is., Torres Strait (AM P.7451) 1 spec.; (AM P.7551) 1 spec.

DISTRIBUTION: Mauritius, New Britain, New Caledonia, Indonesia (Sulawesi), northern Australia (Torres Strait).

REMARKS: This species is very similar to the following, *A. glyptocercus*, which we have illustrated in more detail. The most consistent differences are: (1) *A. glyptocercus* bears a spine on the anterior border of the carapace between the rostrum and the suprantennal spine (missing in *A. acanthus*); (2) *A. acanthus* bears 2-4 spines along the cervical groove (missing in *A. glyptocercus*); (3) the dorsal ridge and spine on article 2 of antenna 2 of *A. acanthus* is armed near its base, mesially with 1 spine and laterally with 2-5 spines (*A.*

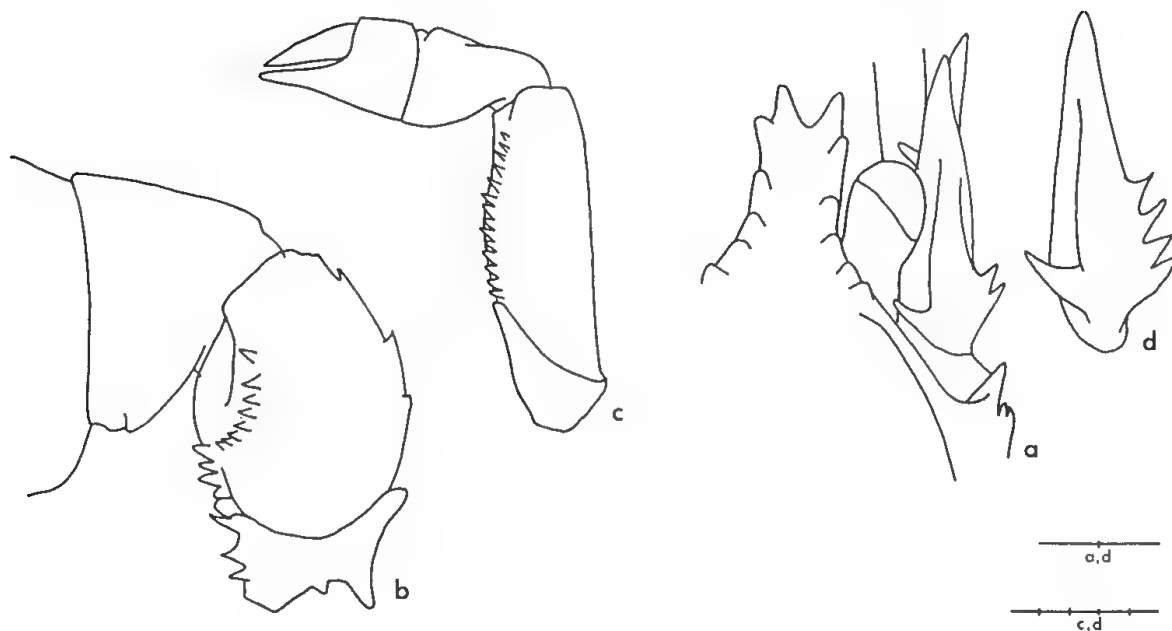


Fig. 7. *Axis acanthus* (AM P.7551, male, 23 mm): a, dorsal view of anterior region; b, proximal articles of large cheliped; c, pereopod 2. (AM P.7451): d, article 2 of antenna 2.

glyptocercus is unarmed here); and (4) lateral spination on the merus of pereopods 1 and 2 is much more pronounced in *A. acanthus* than in *A. glyptocercus*. De Man (1925b) misused the term stylocerite for the dorsal antennal spine. Figure 7 illustrates the differences (1), (3) and (4) above. Our material of *A. acanthus* and *A. glyptocercus* reaffirms De Man's distinction between the two species but some of the differences noted by him are not real. For example, the number of spines on the median carina is variable and not a distinguishing feature.

***Axis* (Neaxis) *glyptocercus* von Martens**

Fig. 8.

Axis glyptocercus von Martens, 1868: 613 (type locality: Cape York). — De Man, 1925a: 4, 13; 1925b: 50-56, fig. 1.

MATERIAL EXAMINED: 21 specimens; cl. 22-38 mm.

Northern Territory: Darwin (AM P.15030) 1 spec., (AM P.18842) 1 spec., (AM P.20358) 1 spec.

Queensland: Fly Point, Cape York (AM P.24813) 2 specs. — Magnetic Is. (QM W.3748) 2 specs. — Townsville (QM W.4533) 1 spec.; (AM P.16176) 1 spec. — Bowen (AM P.16177) 1 spec. — Norwest Is., Capricorn Group (AM P.11829) 1 spec.; (AM P.10060) 1 spec. — Moreton Bay (QM W.1219) 1 spec.; (QM W.1434) 2 spec; (QM W.1072) 1 spec.; (QM W.3649) 1 spec. — Amity Point (QM W.4532) 2 specs. — Dunwich, Stradbroke Is. (AM P.13723) 1 spec.

DESCRIPTION: Rostrum a little longer than basal width, tapering only near base; lateral margins each with 6-7 spines, strongest terminally, most distal pair anteriorly directed and dominating end of rostrum. Anterolateral edge of carapace with a large spine between the eyestalk and antenna 2, another of similar size at the base of the antenna 2 and 4-5 smaller spines between antenna 2 and cervical groove; 2-3 small spines on anterior

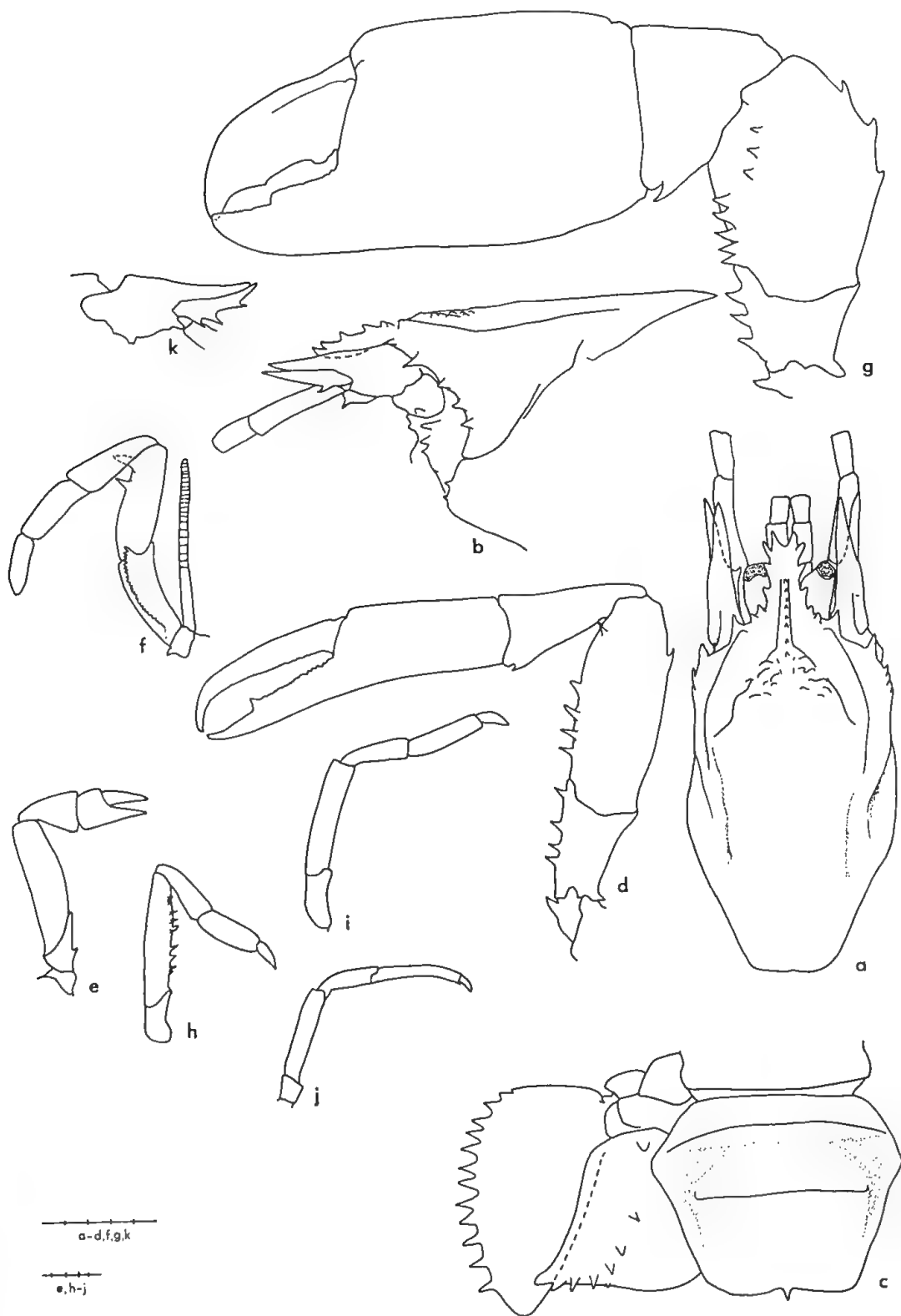


Fig. 8. *Axius glyptocercus* (QM W.4533, female, 27 mm): a, b, dorsal and lateral views of anterior region; c, telson and uropod; d, pereopod 1 (small cheliped form); e, pereopod 2; f, maxilliped 3. (QM W.4532, female, 27 mm): g, large cheliped; h-j, pereopods 3-5. (QM W.3748, female, 31 mm): k, antenna 2, article 2 and scaphocerite.

margin of branchial region of carapace. Frontal region of the carapace depressed except for a median carina bearing 4-7 spines, running back to rugose anterior part of gastric region; dorsolateral margins of carapace smooth. Preoral area spinose. Antenna 2 peduncle longer than that of antenna 1 by more than last article; article 2 dorsally produced to level of end of scaphocerite, dorsal ridge smooth; scaphocerite acute, reaching 0.7 length of article 4, with a median spine near end of eyestalks and 1-3 strong ventral spines; article 3 with a ventral spine; articles 4, 5 unarmed. Eyestalks 0.7 length of rostrum. Maxilliped 3 ischium with curved toothed ridge on mesial surface; merus longer than ischium and with 2-4 medial spines. Chelipeds unequal, not sexually dimorphic. Large cheliped coxa with 2 ventral spines; basis with 2 ventral and 1 mesial spines and a flat distolateral triangular projection; ischium with 3-5 ventral spines and often 1 proximal dorsal spine; merus with 1-4 spines on dorsal margin, 4-5 ventrally and 1-5 laterally near articulation with carpus (the number of spines depending on age); carpus with 1 ventral spine; propod dorsally and ventrally smooth; fixed finger stout, with an obsolete tooth near midpoint; dactyl equal to fixed finger, its cutting edge with a proximal tooth and a very broad projection at the midpoint. Small cheliped similar to the large except in size (e.g., fig. 8d) and in having an acute tooth on cutting edge of fixed finger and a terminally curved dactyl. Pereopod 2 with ventral spines on coxa, basis and ischium; pereopod 3 with ventral spines on coxa and merus (except small specimens); pereopod 4 with ventral spines on coxa; pereopod 5 unarmed. Pleopod 1 (female) 2-articulate, second article the longest, lanceolate. Pleopod 1 (male) absent. Telson wider than long, widest point $\frac{1}{3}$ way along then strongly tapering posteriorly; posterior margin weakly emarginate, with a small spine at its midpoint; 2 strong smooth transverse ridges dorsally. Uropod endopod lateral margin concave distally, a flat spine between this margin and posterior margin, dorsal ridge with 1 proximal and 3-7 distal spines; exopod with a short straight lateral margin; posterior margin curved with 12-14 strong spines.

DISTRIBUTION: Northern Territory (Darwin) through Queensland to Moreton Bay.

REMARKS: *A. glyptocercus* and *A. acanthus* are clearly recognizable among Australian axiids by the emarginate rostrum bearing blunt lateral tubercles and the characteristic ornamentation of the uropods. The differences between *A. glyptocercus* from north-eastern Australia, and the closely related *A. acanthus* from islands north of Australia and Torres Strait, have been discussed by De Man (1925b) and again by us in remarks on the previous species.

***Axius* (Neaxius) *plectorhynchus* Strahl**

Fig. 9.

Axius plectorhynchus Strahl, 1861: 1060-1062, figs 2-4, 11 (type locality: Luzon); 1862: 387.

— Miers, 1884: 282-283. — De Man, 1887: 463-464, pl. 19 fig. 5; 1925a: 4, 13.

Axius plectorhynchus (sic). — Hale, 1927: 84-85, fig. 81.

Axius plectrohynchus (sic). — Coleman, 1977: 135, colour plate.

MATERIAL EXAMINED: 19 males, 25 females; cl. 6-23 mm.

Queensland: Fly Point, Cape York (AM P.24810, 1) 2 specs. — Hayman Is., Whitsunday Group (AM P.7304) 2 specs. — Norwest Islet, Capricorn Group (AM P.8676) 1 spec. — Heron Is. (AM P.20832) 1 spec. — Port Curtis (AM P.25294) 2 specs.

South Australia: no locality (AM P.149) 1 spec.; (AM P.2345, 6) 2 specs.; (AM P.25290) 1 spec. — Sellicks Beach (SAM C.1968) 1 spec. — Petrel Bay, Great Francis Is. (AM P.20966) 1 spec. — Kingscote (AM P.4826) 4 specs.

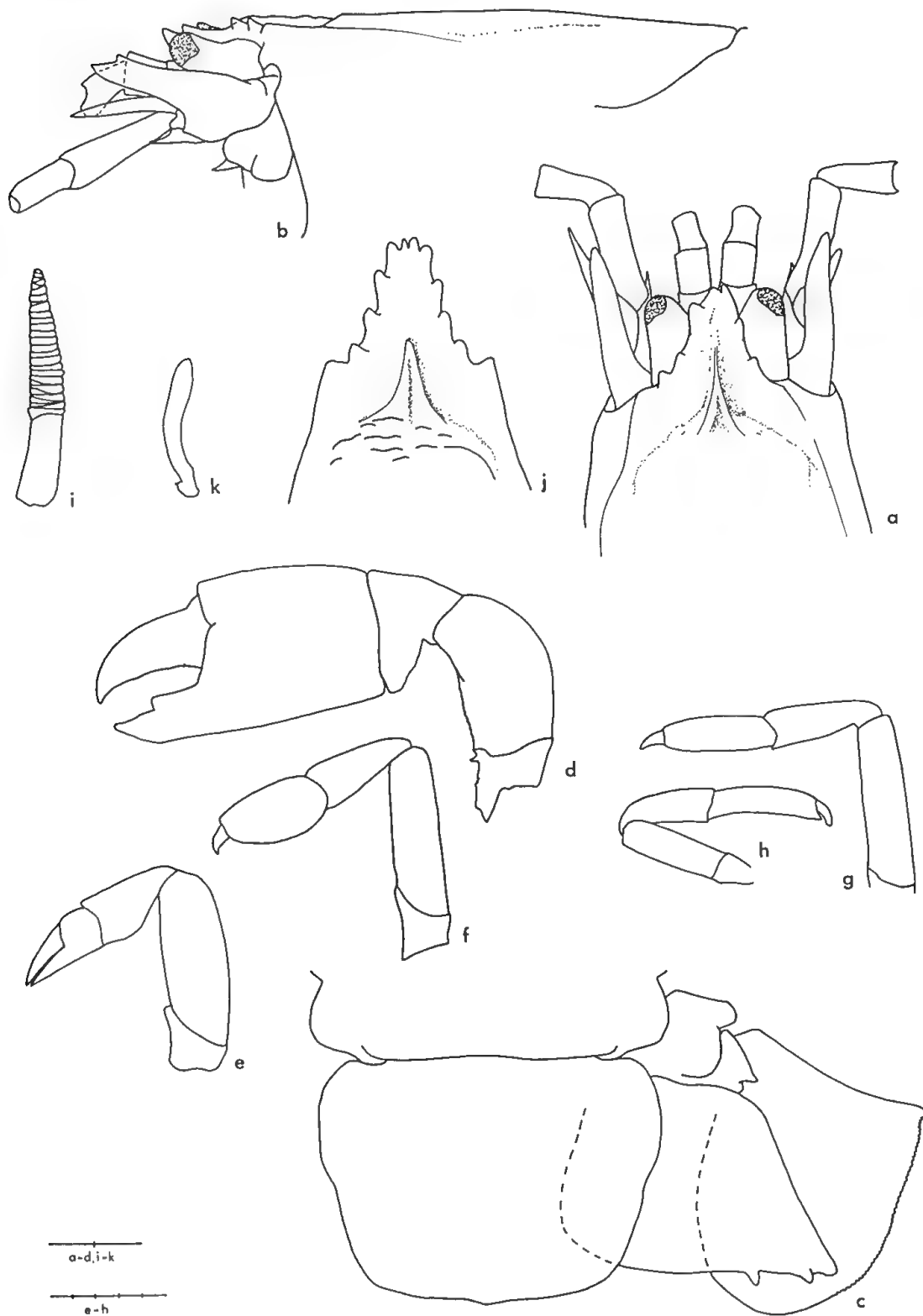


Fig. 9. *Axis plectrorhynchus* (WAM 23-75, female, 19 mm): a, b, dorsal and lateral views of anterior region; c, telson and uropod; d-h, pereopods 1-5; i, pleopod 1. (WAM 167-60, female, 22 mm): j, dorsal view of anterior. (WAM 167-60, male, 17 mm): k, pleopod 1.

Western Australia: Point Peron (WAM 23-75) 1 spec.; (WAM 105-56) 1 spec.; (WAM 19-75) 4 specs.; (WAM 273-65) 1 spec.; (WAM 166-60) 1 spec.; (WAM 67-75) 4 specs. — Cape Naturaliste (WAM 167-60) 2 specs.; (WAM 55-75) 2 specs. — Carnac Is. (WAM 11-75) 5 specs. — Gordie Bay, Rottnest Is. (WAM 303-65) 2 specs. — Hamelin Bay (WAM 21-75) 2 specs. — no locality (WAM 224) 1 spec.

DESCRIPTION: Rostrum little longer than width at base, lateral margin concave, dentition asymmetrical, 4-6 strong, blunt teeth on each side. Gastric region rugose, sloping gradually down to rostrum; a prominent triangular median carina in front of the gastric region narrows and slopes down, usually steeply, at the base of the rostrum, sometimes acute anteriorly; lateral carinae end anteriorly at base of rostrum as blunt teeth distinctly out of line of rostral teeth. Antenna 1 peduncle not reaching to end of article 4 of antenna 2, stylocerite a minute spine. Antenna 2 with a ventral spine on article 1; a dorsal ridge on article 2 extending forward as a strong spine (a blade sometimes); scaphocerite a prominent spine almost reaching to end of article 4; article 3 with a medioventral spine. Eyestalks reaching almost to end of rostrum and clearly visible dorsally. Maxilliped 3 merus with 2 spines medially. Chelipeds equal, not sexually dimorphic. Cheliped coxa with 2 spines and basis with 1 spine on posteromedial edge; ischium with a distal spine on the ventral margin; merus minutely ventrally serrate; propod stout, unarmed; fixed finger cutting edge with a prominent blunt tooth midway along; dactyl equal to fixed finger, cutting edge smooth; ratio of dorsal lengths — merus: carpus: propod — 1:0.6:1. Pereopods 2-4 with spines on coxae, otherwise pereopods unarmed. Pleopod 1 (female) uniramous, multiarticulate flagellum 1.5 times as long as first article. Pleopod 1 (male) a single curved article. Telson 1.5 times as wide as long, broadest about $\frac{1}{3}$ way along, posterior to which lateral margins constrict and then taper to be continuous with posterior margin; sometimes a medial spine on posterior margin; dorsally smooth or with 2 obsolete spines. Uropod endopod with broad anterior free margin, lateral margin slightly concave and ending posteriorly in a squamiform spine; posterior margin slightly convex with 2 (rarely 3) additional spines, the most medial one, ending the dorsal rib, often acute, dorsal ridge sometimes with 1-3 spines; exopod 1.2 times as wide as long, widest at midpoint, lateral margin concave, ending posteriorly in a squamiform spine, posterior and medial margins continuous, minutely crenulate distally, free proximal margin parallel to posterior margin.

DISTRIBUTION: Intertidal — 13 m, reef and coral; Indonesia (Seram), Queensland, South Australia and Western Australia.

REMARKS: *Axius plectrorhynchus* is one of the more widespread and common axiids in Australia but taxonomically one of the most poorly known. It is easily confused with the smaller *A. waroona* whose range it overlaps. The two species are compared following the description of the latter species. De Man's (1925a) key allows identification of the species but it has not been adequately described or figured previously. Hale (1927) and Coleman (1977) misspelt the specific name.

***Axius* (*Neaxius*) *waroona* n. sp.**

Fig. 10.

Axius plectrorhynchus. — Fulton & Grant, 1902: 60-61, pl. 5 figs 7,8. (Not *Axius plectrorhynchus* Strahl, 1861.)

Axius plectorchynchus (sic) "small variety". — Hale, 1927: 84.

MATERIAL EXAMINED: 12 males, 12 females, 4 others; cl. 6-13 mm.

HOLOTYPE: WAM 20-75, ovigerous female, cl. 8 mm.



Fig. 10. *Axius waroona* (WAM 20-75, female, 8 mm): a, b, dorsal and lateral views of anterior region; c, telson and uropod; d, cheliped. (WAM 151-76, male, 7 mm): e, rostrum.

TYPE LOCALITY: *Western Australia*: N. side of Cape Naturaliste, "below lighthouse, building mud tubes under intertidal stones", coll. B. R. Wilson and S. Slack-Smith, 9th December, 1965.

PARATYPES: *Queensland*: Murray Is., Torres Strait (AM P.24662) 1 spec. — Masthead Is. (AM G.5757) 1 spec.

Victoria: (localities in doubt) Beaumaris (SAM C.880) 4 specs. — Flinders (AM P.25291) 5 specs.

Tasmania: Jacobs Boat Harbour (TM G.1638) 1 spec.

South Australia: Kingscote, Kangaroo Is. (AM P.4841) 2 specs.

Western Australia: Edward Is., Lancelin (AM P.24664) 3 specs. — Bathurst Pt., Rottnest Is. (WAM 174-31) 1 spec.; (WAM 130-75) 1 spec. — Garden Is. (WAM 432-73) 2 specs. — Cowaramup Bay (WAM 9-75) 2 specs. — Cape Naturaliste (WAM 151-76) 2 specs. — Albany (WAM 73-75) 2 specs.

DESCRIPTION: Rostrum little over half as long as width at base, somewhat depressed, lateral margins convex, marginal ornamentation varying from an obsolete tuberculate ridge to sometimes 4-6 small acute spines per side. Gastric region usually somewhat rugose, sloping down to rostrum; a triangular median carina in front of the gastric region ends indefinitely anteriorly; Lateral carinae run into margins of rostrum without disruption. Antenna 1 peduncle reaching to about end of article 4 of antenna 2. Antenna 2 with a small ventral spine on article 1; a dorsal ridge on article 2 extending forward as a strong spine; scaphocerite a prominent downcurved spine; article 3 with a small medioventral spine. Eyestalks not reaching end of rostrum, largely obscured dorsally. Chelipeds equal, not sexually dimorphic. Cheliped ischium with a distal spine on the ventral margin; merus irregularly dentate ventrally; propod, stout, unarmed; fixed finger cutting edge with a prominent sharp tooth midway along; dactyl subequal to fixed finger, cutting edge smooth; ratio of dorsal lengths — merus: carpus: propod — 1:0.5:1. Pereopods 2-4 with spines on coxae, otherwise pereopods unarmed. Pleopods as in *A. plectrorhynchus*. Telson about 1.3 times as wide as long, broadest near proximal margin, lateral margins tapering to be continuous with posterior margin; sometimes a medial spine on posterior margin; dorsally smooth or with 2 obsolete spines. Uropod endopod with little anterior free margin, lateral margin slightly concave proximally, straight distally and ending in small spine; posterior margin weakly convex with small acute spine at the end of the dorsal ridge (rarely a third intermediate marginal spine); dorsal ridge usually smooth, rarely bearing a small spine; exopod little longer than wide, widest about $\frac{2}{3}$ way along, lateral margin straight-concave, ending in a minute spine, posterior and medial margins continuous.

DISTRIBUTION: Intertidal, under rocks; Queensland, Victoria, Tasmania, South Australia and Western Australia.

REMARKS: *Axius waroona* is most closely related to the previous species, *A. plectrorhynchus*. Hale (1927) noted a "small variety" in specimens of *A. plectrorhynchus* from South Australia. *A. waroona* differs in several subtle characters as well as its smaller size, notably the spination of the rostrum (usually obsolete in *A. waroona*), the lateral lobes of the rostrum not being distinct, and especially the uropod rami being more triangular in *A. waroona*. The form of the rami of the uropods is probably the clearest feature distinguishing the two species.

Scytoleptus Gerstaecker, 1856

DIAGNOSIS: Uropod rami without sutures; eyestalks cylindrical; dorsum falling steeply to rostrum; scaphocerite minute.

Scytoleptus serripes Gerstaecker

Fig. 11.

Scytoleptus serripes Gerstaecker, 1856: 158, pl. 6 figs 1-4 (type locality: South Africa). — Strahl, 1861: 1055. — Hilgendorf, 1878: 827. — Lenz, 1905: 379. — Bouvier, 1915: 198-200, figs. 8, 9. — De Man, 1925a: 5, 49-53, fig. 9. — Barnard, 1950: 499. — Fourmanoir, 1955: 30-31.

Evaxius tricarinatus Kingsley, 1882: 130-131, pl. 1 fig. 1.

MATERIAL EXAMINED: 13 females, 6 males; cl. 5-46 mm.

Northern Territory: Cape Wessel (QM W.4531) 3 specs. — West Point, Darwin (WAM 68-77) 2 specs. — Fannie Bay, Darwin (AM P.24670) 1 spec.

Western Australia: Cockatoo Is. (WAM 125-75) 1 spec. — Quongdong Reef, Broome (WAM 58-75) 2 specs. — Port Hedland (WAM 78-75) 1 spec. — Dampier Archipelago: Kendrew Is., (WAM 6-75) 1 spec.; (WAM 15-75) 1 spec.; Bezont Is. (WAM 74-75) 1 spec.; Delambre Is. (WAM 283-65) 3 specs.; Angel Is. (WAM 47-75) 2 specs. — Exmouth Gulf (WAM 280-65) 1 spec.

DESCRIPTION: Rostrum broad basally with 1 pair of blunt lateral spines, tapering abruptly to narrow tip, dorsally concave. Gastric region falling steeply to rostrum, its median carina obsolete dorsally and ending anteriorly in a blunt corner or sometimes a sharp spine; the anterior vertical ridge with 1 or 2 more or less acute, short spines midway down; single pair of obsolete lateral carinae ending anteriorly in sharp or rounded corners; cervical groove and linea thalassinica indistinct. Antenna 1 peduncle reaching about a third along length of article 4 of antenna 2, unarmed. Antenna 2 with a small ventral spine on article 1; article 2 unarmed, scaphocerite a small triangular plate; article 4 elongate, 4 times as long as article 2. Eyestalks about half length of rostrum. Maxilliped 3 ischium with a pronounced curved toothed ridge on mesial surface; merus with a strong medial terminal spine. Chelipeds unequal, not sexually dimorphic. Large cheliped usually unarmed, but sometimes an irregular dentate ridge on ventral margin of merus; fixed finger stout, cutting edge irregular and slightly toothed; dactyl little longer than fixed finger, stout, curved, unarmed; ratio of dorsal lengths — merus: carpus: propod — 1:0.5:1.3. Small cheliped narrow, unarmed except sometimes a blunt spine ventrally on merus; fixed finger irregularly dentate. Pereopods 2-5 without fixed armature but propod and dactyl of pereopods 3, 4 bear numerous short black articulating spines laterally and ventrally. Pleopod 1 (female) uniramous, first article as long as multiarticulate flagellum. Pleopod 1 (male) a single narrow curved article. Telson longer than broad, lateral margins with a small proximal spine, a small spine at midpoint of convex posterior edge; strongly convex dorsally, spinose and setose. Uropod endopod little shorter than telson, with a spinose longitudinal ridge and 2 spines on posterior margin; exopod with convex, continuous lateral and posterior margins, spinose dorsally and on posterior margin.

DISTRIBUTION: Intertidal reefs; Mauritius, Madagascar, Aldabra Is., South Africa, Mozambique, Zanzibar Is., Indonesia, northern and northwestern Australia. The present specimens represent the first records from Australia.

REMARKS: This distinctive species is the sole representative of its genus. The steeply falling gastric region above the short dished rostrum easily distinguishes it from all other

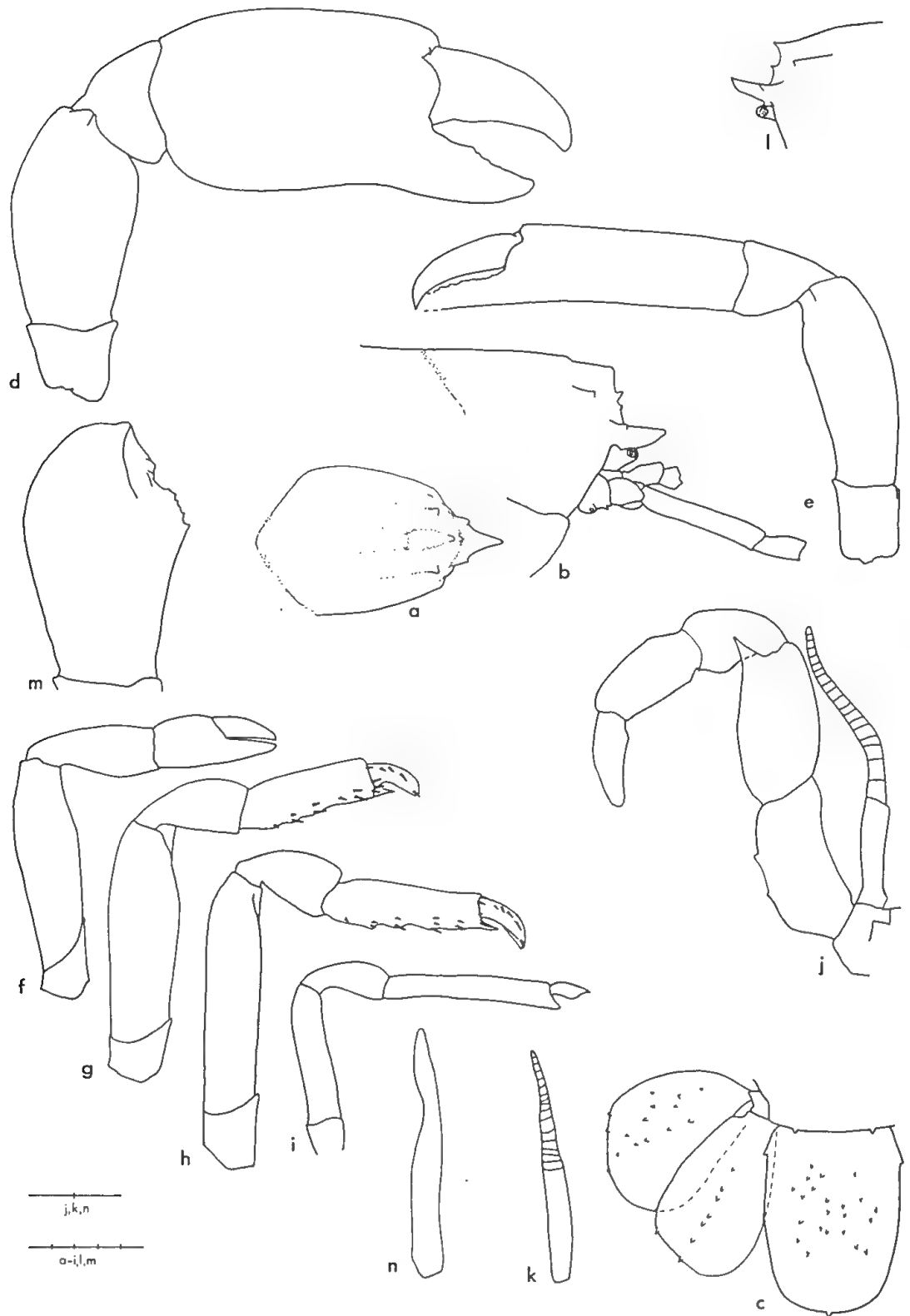


Fig. 11. *Scytoleptus serripes* (QM W.4531, female, 20 mm): a, b, dorsal and lateral views of anterior region; c, telson and uropod; d, large cheliped; e, small cheliped; f-i, pereopods 2-5; j, maxilliped 3; k, pleopod 1. (QM W.4531, female, 16 mm): l, lateral view of anterior. (WAM 74-75, female, 18 mm): m, merus of large cheliped. (WAM 47-75, male, 21 mm): n, pleopod 1.

thalassinideans. *Scytoleptus serripes* is the only Australian thalassinidean found also in southern Africa.

Family **Callianassidae** Dana, 1852

Callianassa Leach, 1814

DIAGNOSIS: Dorsal oval of the carapace, the area delimited by the cervical groove, obvious and longer than the cardiac region behind it; well developed linea thalassinica; rostrum flattened, triangular and short or spinous or lacking. Eystalks flat, eye on dorsal surface. Maxilliped 3 usually lacking exopod, operculiform or pediform. Chelipeds usually unequal.

REMARKS: The above diagnosis serves to distinguish *Callianassa senso latu* from the two other genera known from Australia, *Ctenocheles* and *Gourretia*. Biffar (1971a) has given a more extensive description. We have had some difficulty in placing some of the Australian callianassid species in the new genera erected by de Saint Laurent (1973) (see also Poore, 1975) and therefore prefer not to follow her arrangement. The exception is her new genus *Gourretia* which forms a relatively homogeneous group of species clearly distinct from the remainder of the family.

Callianassa aequimana Baker

Figs 12, 13

Callianassa aequimana Baker, 1907: 182-185, pl. 24 figs 1-8 (type locality: South Australia, Kingston). — Hale, 1927: 87, fig. 83. — De Man, 1928a: 28, 114: 1928b: 48-51.

MATERIAL EXAMINED: 16 males, 18 females; tl. 9-84 mm.

Queensland: Northwest Islet, Capricorn Group (AM P.10356) 1 spec.

New South Wales: Balmoral Beach, (AM P.3636) 1 spec.

Victoria: Shoreham (AM G.5776) 1 spec.; (AM G.5769) 1 spec. — Port Phillip Bay (PPBES stn 953) 4 specs. — Crib Point, Western Port (CPBS stn 00) 2 specs.

South Australia: Kingston (AM P. 148) 1 spec.; (SAM C. 902, paratypes) 2 specs. — Port McDonnell (NMV) 1 spec.

Western Australia: Houtman Abrolhos Is. (WAM 253-65) 1 spec. — Dalkeith, Swan River (WAM 10842) 1 spec. — Fremantle Harbour (WAM 71-75) 1 spec. — Garden Is. (WAM 46-75) 2 specs; (WAM 9544) 1 spec.; (WAM 14-75) 1 spec. — Rockingham, Cockburn Sound (WAM 12-75) 1 spec. — Mandurah (AM P.11887) 1 spec.; (WAM 17-75) 1 spec. — Peel Inlet (WAM 7-75) 2 specs. — Bunbury (AM P.13717) 1 spec.; (WAM 199-34) 1 spec.; (WAM 70-75) 1 spec.; (WAM 31-75) 1 spec. — Leschenault Estuary, Bunbury (WAM 26-75) 1 spec. — Albany (WAM 35-75) 1 spec.; (WAM 116-52) 1 spec. — Cheyne Beach (WAM 27-75) 1 spec.

DESCRIPTION: Dorsal oval 0.6 length of dorsal carapace. Rostrum variable, usually very short, broad, triangular, anteriorly blunt, less than 0.2 length of eyestalks; lateral projections as long as rostrum, blunt; postrostral area gently sloping anteriorly, often with 3 broad obsolete ridges running on to rostrum and anterior margin. Eyestalks extending as far as distal edge of first article of antenna 1, anteromedial angle subacute; pigmented area subdistal, circular. Peduncle of antenna 1 reaching just beyond article 4 of antenna 2. Maxilliped 3 merus width 0.6-0.7 length of ischium and merus together, merus little shorter than ischium; ischium with row of about 24 spines along midline of inner surface; carpus articulating terminally on merus, subovate; propod subovate, lateral edge weakly curved,

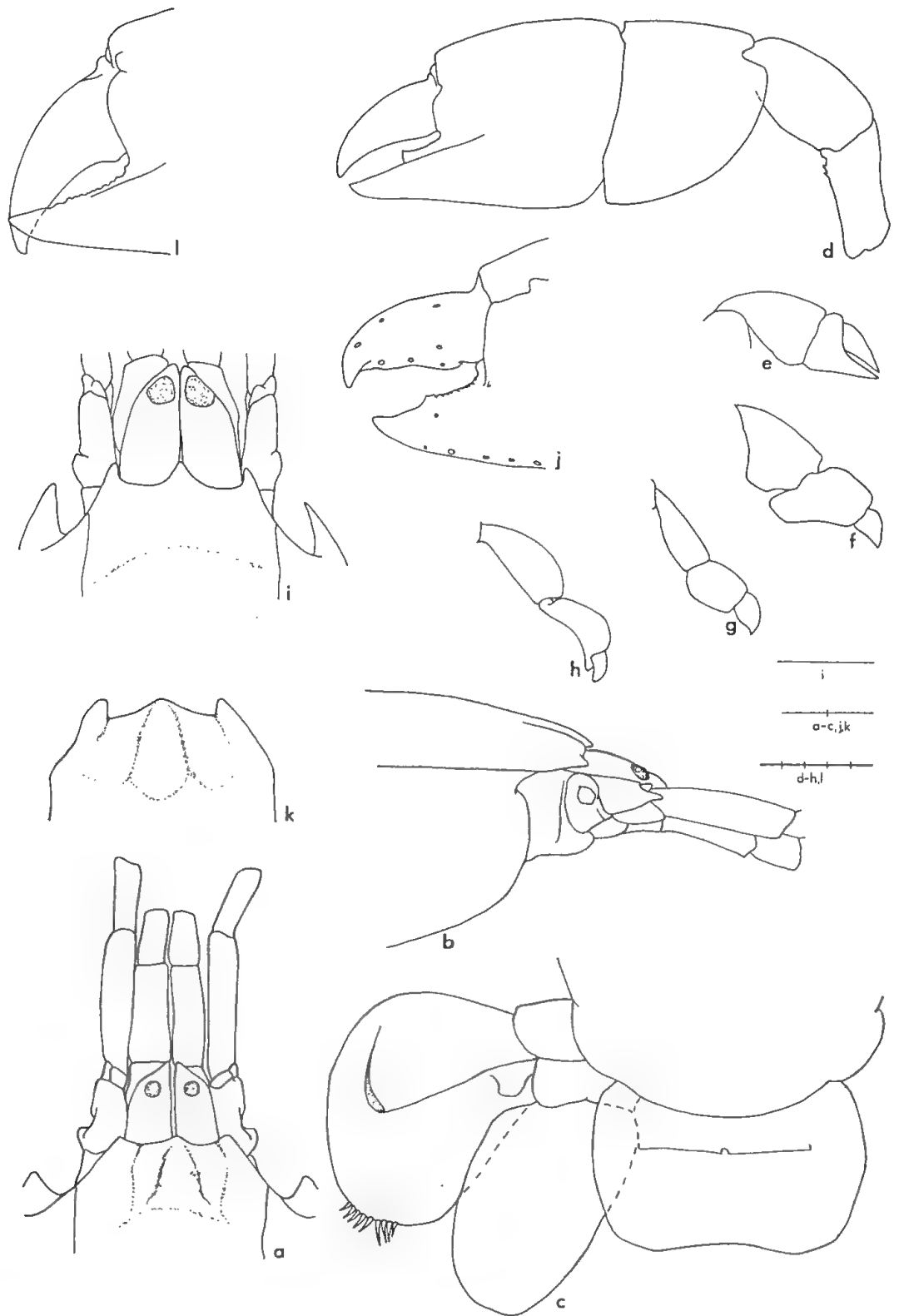


Fig. 12. *Callianassa aequimana* (AM P.148, female, 56 mm): a, b, dorsal and lateral views of anterior region; c, telson and uropod; d, cheliped; e-h, pereopods 2-5 (terminal articles only). (AM P.10356, female, 37 mm): i, anterior; j, chela (medial view). (AM P.3636, male, 81 mm): k, anterior of carapace, l, chela (medial view).

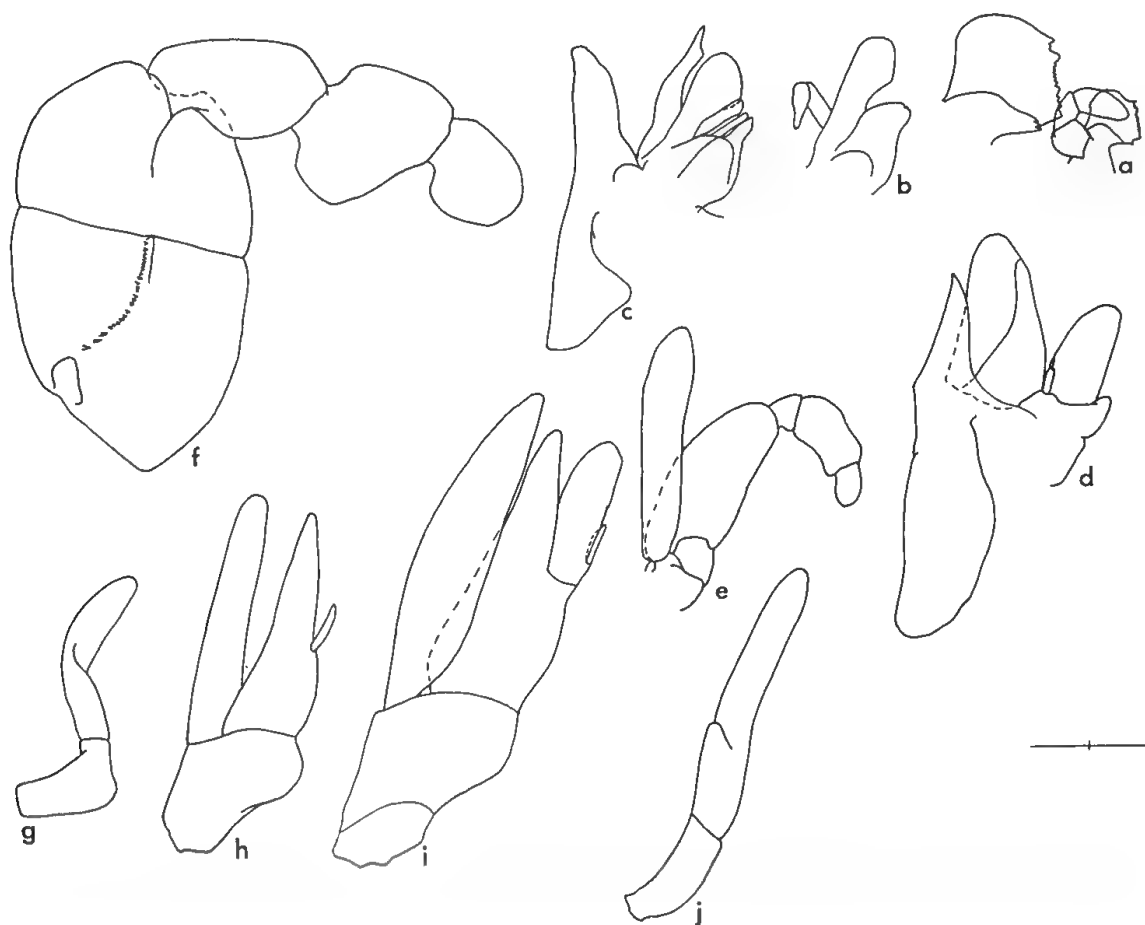


Fig. 13. *Callianassa aequimana* (AM P.148, female, 56 mm): a, mandible (with detail); b, c, maxillae 1, 2; d-f, maxillipeds 1-3; g, h, pleopods 1, 2. (AM P.3636, male, 37 mm): i, j, pleopods 1, 2.

medially lobed, width twice length; dactyl subovate, width half that of propod. Chelipeds equal and similar in both sexes; ischium weakly serrate ventrally, 2 or 3 strong spines distally; merus unarmed, dorsally carinate; carpus about 1.5 times as wide as long; propod carinate dorsally and ventrally, dorsal edge sometimes produced distally; fixed finger tapering to end, a variably sized tooth at proximal third, proximal half generally denticulate; dactyl about as long as fixed finger, tapering to downcurved end; cutting edge usually smooth but sometimes with obsolete proximal teeth; ratio of dorsal lengths — merus: carpus: propod — 1:0.85 — 0.95:0.9. Pleopod 1 (female) uniramous, 2-articulate second article curved. Pleopod 2 (female) biramous, exopod straight, subequal to distal lobe of first article of 2-articulate endopod. Pleopod 1 (male) uniramous, 2-articulate, distal article medially lobed. Pleopod 2 (male) biramous, endopod 3-articulate, first and second articles distally lobed, lobes of equal length, third article small. Telson with weakly concave posterior edge, sides weakly convex, length just over half greatest width; surface with a transverse ridge close to base, a tuft of setae arising from notch at centre of ridge. Uropod endopod ovate, greatest width midway along, almost twice as long as wide, 1.5 times as long as telson, margin barely setose; exopod slightly shorter than endopod, length 1.3 times width, greatest width midway along, setae and few spines on posterior edge.

DISTRIBUTION: Intertidal and subtidal mudflats down to 9 m, often in estuaries;

southern Queensland through N.S.W., Victoria, South Australia, to south Western Australia.

REMARKS: There is good agreement between this material and that described by Baker (1907), but we have noted considerable variation especially with size. The postrostral area can be smooth or, in larger specimens, have broad obsolete longitudinal ridges. The rostrum varies from almost absent to quite prominent and the rami of the uropods become more elongate with increasing size. We cannot confidently place this species in any of de Saint Laurent's (1973) genera of the Callianassidae.

***Callianassa amboinensis* De Man**

Fig. 14.

Callianassa amboinensis De Man, 1887: 480-482, pl. 20 fig. 4 (type locality: Indonesia, Ambon); 1928a: 27, 107, 165-170, pl. 18 fig. 28. — Zehntner, 1894: 194. — Borradaile, 1903: 545.

MATERIAL EXAMINED: 2 females, tl. 44 mm.

Western Australia: 3-4 mi (4.8-6.4 km) off E. end of Delambre Is. Dampier Archipelago, 18 m (WAM 119-75) 1 spec.; (WAM 120-75) 1 carapace.

DESCRIPTION: Dorsal oval 0.75 length of dorsal carapace. Rostrum flat, very broad, obtuse, less than 0.2 length of eyestalks; lateral projections obsolete. Eyestalks extending just beyond end of first article of antenna 1, with a long, broad, rounded mesiodistal lobe beyond the large lateral eyes. Peduncle of antenna 1 reaching beyond end of peduncle of antenna 2; neither antenna very setose. Maxilliped 3 merus width 0.8 length of ischium and merus together, merus shorter than ischium; ischium with curved row of 25 small teeth on mesial surface; carpus articulating distally on merus, subovate; propod tapering; dactyl narrow, tapering. Large cheliped (female) ischium dentate ventrally; merus with evenly curved minutely dentate ventral margin, dorsal margin convex; carpus about 1.3 times as wide as long, dorsally and ventrally smooth; propod dorsally and ventrally smooth; fixed finger stout, cutting edge minutely serrate; dactyl equal to fixed finger, strongly curved at end, minutely serrate; ratio of dorsal lengths — merus: carpus: propod — 1:0.8:1.5. Large cheliped (male) unknown. Small cheliped of similar proportions to large cheliped, about 0.7 times its length. Pleopod 1 (female) 2-articulate. Pleopod 2 (female) biramous, both rami 2-articulate, endopod longer than exopod. Pleopods (male) unknown. Telson little wider than long, lateral edges strongly curved and continuous with weakly concave posterior edge, a minute spine at midpoint of posterior edge; long setae terminally. Uropod endopod subovate, little longer than telson, with setose margin; exopod about as long as endopod, lateral margin almost straight, distal and medial margins convex, continuous, wider than long, greatest width at midpoint, with setose margin.

DISTRIBUTION: Reef to 18 m; Indonesia, north Western Australia. The present specimens represent the first records from Australia.

REMARKS: Without seeing the types or other specimens of *C. amboinensis* it is difficult to separate the two specimens from north Western Australia from De Man's (1887, 1928a) descriptions and figures. There is close resemblance in the antennae, tail fan, maxilliped 3 and propod of pereopod 3. Features where our specimens differ are the absence of acute ends on the eyestalks, a blunter rostrum, and some dentition on the ischium and merus of the large cheliped — all characteristics which can vary with age, sex or size. Given the geographical proximity of the collecting sites we feel confident in assigning these specimens to *C. amboinensis*.

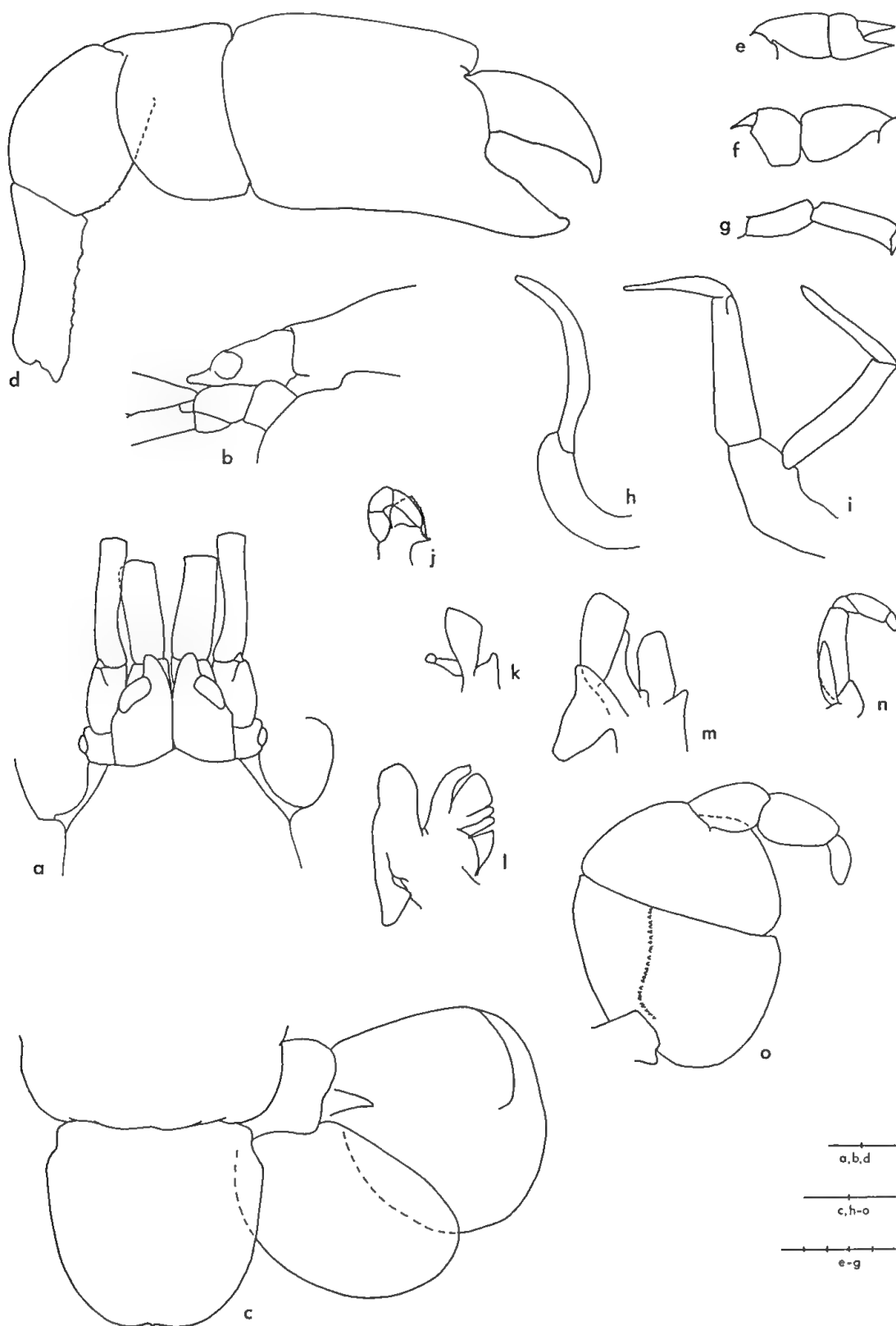


Fig. 14. *Callianassa amboinensis* (WAM 119-75, female, 44 mm): a, b, dorsal and lateral views of anterior region; c, telson and uropod; d, large cheliped; e, f, g, pereopods 2, 3, 5 (terminal articles); h, i, pleopods 1, 2; j, mandible; k, l, maxillae 1, 2; m-o maxillipeds 1-3.

***Callianassa arenosa* Poore**

Figs 15-17

Callianassa arenosa Poore, 1975: 197-201, figs 1-2 (type locality: Victoria, Port Phillip Bay).

MATERIAL EXAMINED: 63 specs. tl. 10-43 mm.

Queensland: Moreton Bay (QUBS) 16 specs. — Pelican Banks, Moreton Bay (CSIRO) 2 specs. — Bird Is., Moreton Bay (QM W.832) 3 specs. — 1 mile S. of Southwest Rocks, Moreton Bay (QM W.3977) 1 spec.; (QM W.3978) 2 specs. — Dunwich (QM W.2037) 2 specs.

New South Wales: Careel Bay (AM P.20797) 1 spec.; (AM P.20796) 1 spec.; (AM P.19961) 1 spec.; (AM P.19960) 1 spec.; (AM P.15694) 1 spec.; (AM P.24667) 1 spec.; (AM P.24668) 1 spec.; (AM P.24669) 1 spec. — Mort Bay (AM P.16240) 1 spec. — Sailors Bay, Sydney Harbour (AM P.24665) 3 specs; (AM P.24666) 2 specs. — Mosman Bay (AM G.5775) 2 specs. — Gunnamatta Bay (CSIRO) 1 spec. — Tuross R. (AM P.24690) 1 spec. — Merimbula (NMV Kudenov colln) 4 specs.

Victoria: Raymond Is., Gippsland Lakes (NMV) 2 specs. — Seaport (AM P.8700) 1 spec. — French Is. (NM V) 1 spec. — Warrnambool, Hopkins R. (NM V Kudenov colln) 1 spec.

Tasmania: Margate (TM G.395) 2 specs. — Midway Point (TM G.1583) 8 specs.

DISTRIBUTION: Intertidal to shallow subtidal sand and mudflats, often in estuarine situations; southern Queensland, N.S.W., Victoria and Tasmania.

REMARKS: This species was originally described from survey material from Port Phillip Bay and Western Port in Victoria. The range of this species is here extended south to Tasmania and north through N.S.W. to southern Queensland. A large male (43 mm) is illustrated (fig. 17) to show more pronounced dentition of the dactyl of the cheliped than noted in the previous description. Figures 15 and 16 are from Poore (1975).

***Callianassa australiensis* (Dana)**

Figs 18-20

Trypaea australiensis Dana, 1852: 573, pl. 32 fig. 4 (type locality: New South Wales, Illawarra district). — Fulton & Grant, 1906: 14-15.

Trypaea porcellana Kinahan, 1858: 130, pl. 4 fig. 2.

Callianassa (Trypaea) australiensis. — De Man, 1928a: 27, 104. — Stephenson et al., 1931: 56. — Dakin & Colefax, 1940: 182-184, figs 270, 271 (larvae). — Gurney, 1944: figs 8, 9. — Dakin et al., 1952: 199, pl. 44. — Hailstone & Stephenson, 1961: 259-285, figs 1-15, pls 1-3. — Hailstone, 1962: 29-31, 2 figs. — McNeill, 1968: 26. — Healy & Yaldwyn, 1970: pl. 30.

MATERIAL EXAMINED: more than 409 specs; tl. 16-63 mm.

Queensland: Townsville Harbour (AM P.16236) 13 specs. — Bowen Harbour (AM P.5193) 1 spec.; (AM P.5982) 4 specs. — Mackay (QM W.75) 1 spec. — Boyne River (AM P.17338) 9 specs; (AM P.17403) 136 specs; (AM P.16875) 9 specs. — Brisbane (WAM 10-75) 1 spec. — Amity, Moreton Bay (QM W.241) 2 specs. — Bird Is., Moreton Bay (QM W.832) 1 spec. — Beenleigh (QM W.86) 1 spec. — Nerang River, Southport (NMV) several specs.

New South Wales: Richmond River (near Ballina) (AM P.12941) 2 specs. — Trial Bay (AM P.4603) 1 spec. — Red Bank River (N. of Coffs Harbour) (AM P.12120) 3 specs. — Bellinger River (AM P.4743) 2 specs. — Patonga Creek (AM P.16237) 1 spec. — Sirius Cove (AM

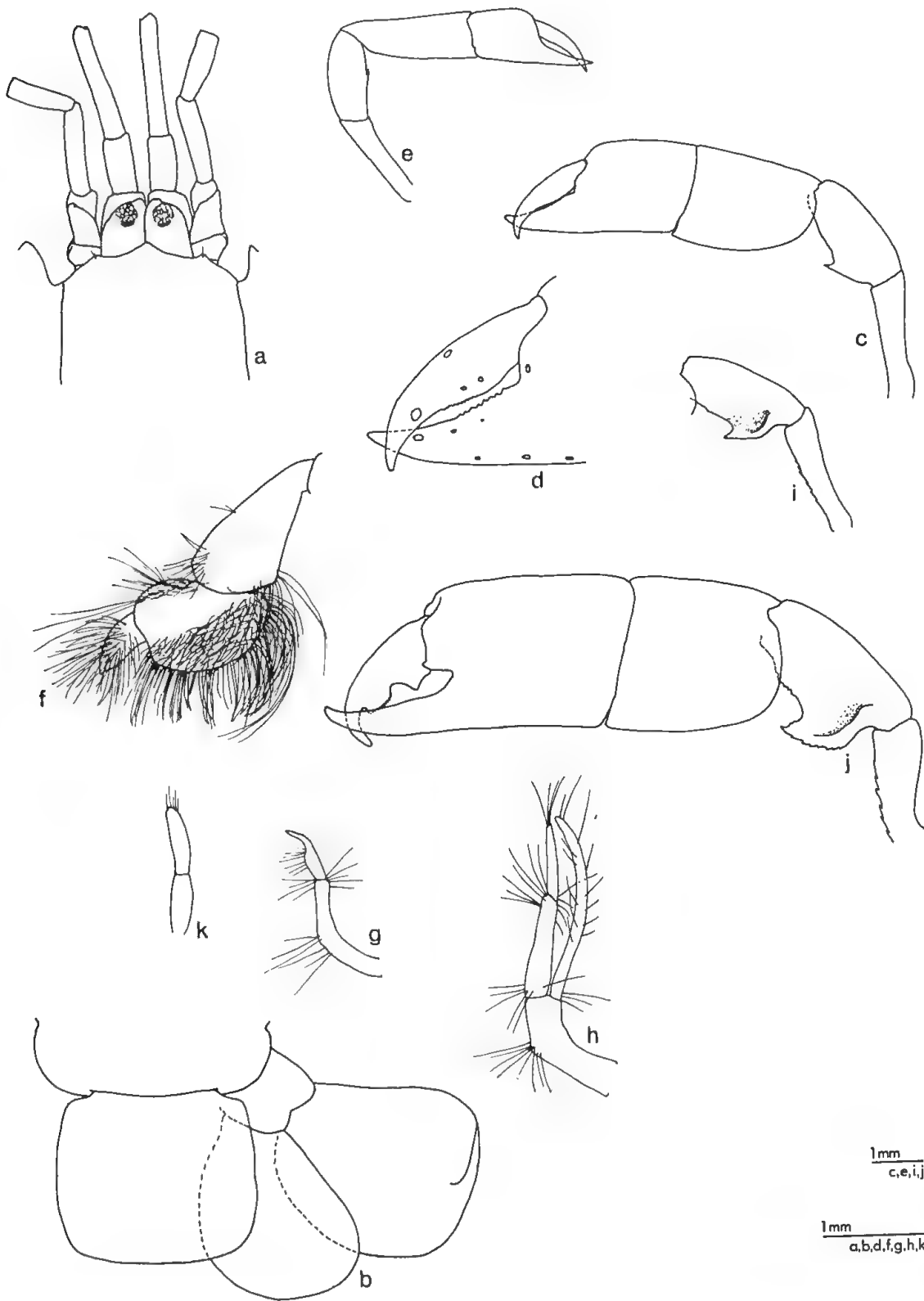


Fig. 15. *Callianassa arenosa* (NMV J.271, female, 24 mm (holotype)): a, front; b, tail fan; c, d, large cheliped (left); e, small cheliped (right); f, pereopod 3; g, h, pleopods 1, 2. (PPBES stn 982, female, 20 mm): i, large cheliped ischium and merus. (NMV J.272, male, 22 mm (allotype)): j, large cheliped (left); k, pleopod 1.

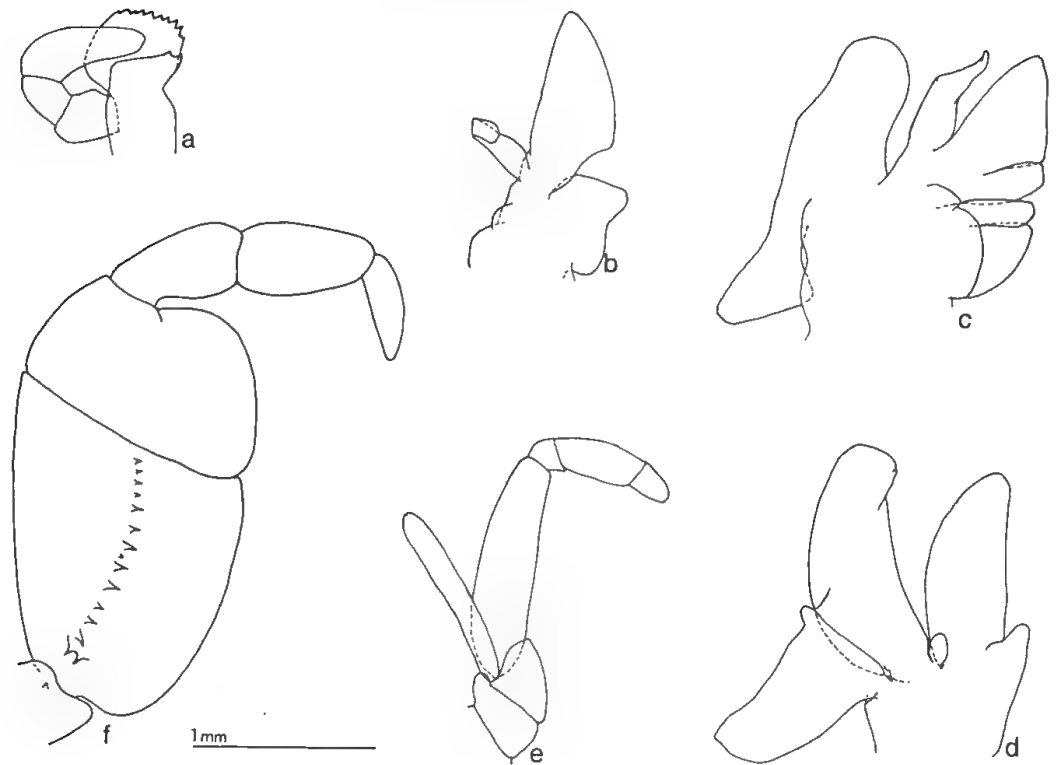


Fig. 16. *Callianassa arenosa* (NMV J.271, female, 24 mm (holotype)): a, mandible; b, c, maxillae 1, 2; d, e-f, maxillipeds 1-2-3.

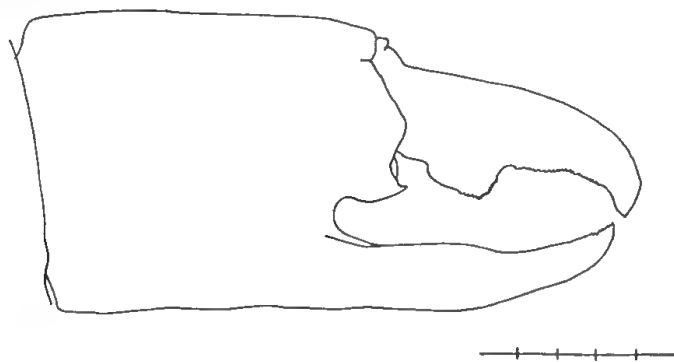


Fig. 17. *Callianassa arenosa* (AM P.16239, male, 43 mm): chela.

G.5690) 1 spec. — Off Sow and Pigs Shoal, Port Jackson (AM P.9402) 17 specs. — Sydney foreshore (AM P.12940) 6 specs. — near Roseville Bridge (AM P.15904) 5 specs. — Towra Point, Botany Bay (AM P.4744) 1 spec. — Hacking River (AM P.9385) 5 specs. — Port Kembla (AM G.5771) 2 specs. — 'Illawarra' (AM G.5673) 2 specs. — Batemans Bay (AM P.4674) 3 specs. — Murrah Lake (AM P.4745) 1 spec. — Merimbula (NMV Kudenov colln) 1 spec.

Victoria: Port Welshpool (NMV) several specs. — Mallacoota Inlet (NMV) 3 specs; (NMV Kudenov colln) 1 spec. — Western Port (NMV) 1 spec; (NMV Fulton colln) several specs; (NMV) many specs. — (AM P.4061) 2 specs. — French Is., Western Port (NMV) 3 specs. — Crib Point, Western Port (CPBS stns A2, C6, 24N, 25N, 31E, 34S) 159 specs. — Stony Point, Western Port (AM G.5774) 5 specs. — Port Phillip Bay (AM G.5672) 4 specs; (PPBES stn 955) 1 spec. — Sandridge, Port Melbourne (NMV) several specs.

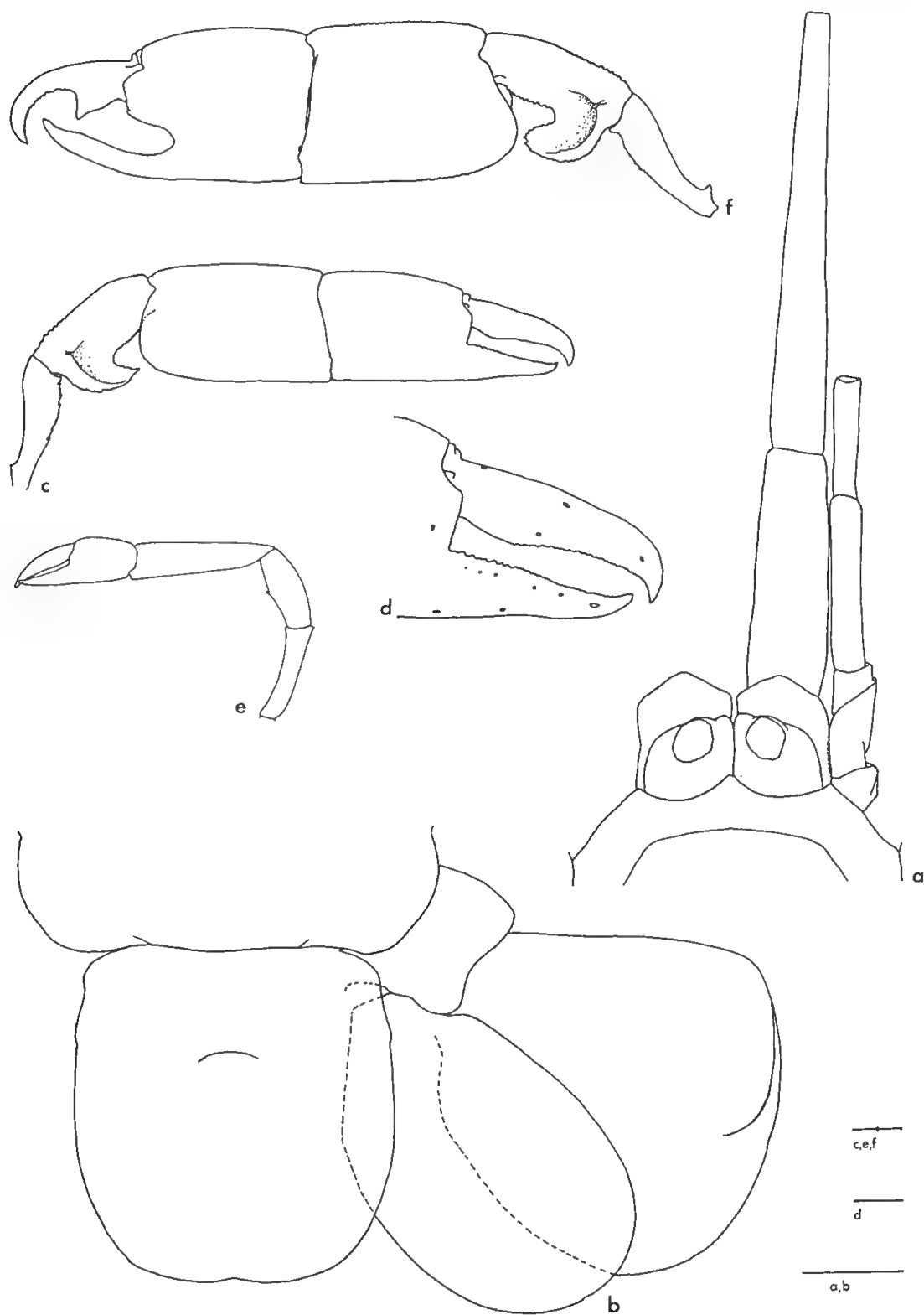


Fig. 18. *Callianassa australiensis* (CPBS stn 25N, female, 32 mm): a, dorsal view of anterior region; b, telson and uropod; c, d, large cheliped and detail; e, small cheliped. (CPBS stn 25N, male, 36 mm): f, large cheliped.

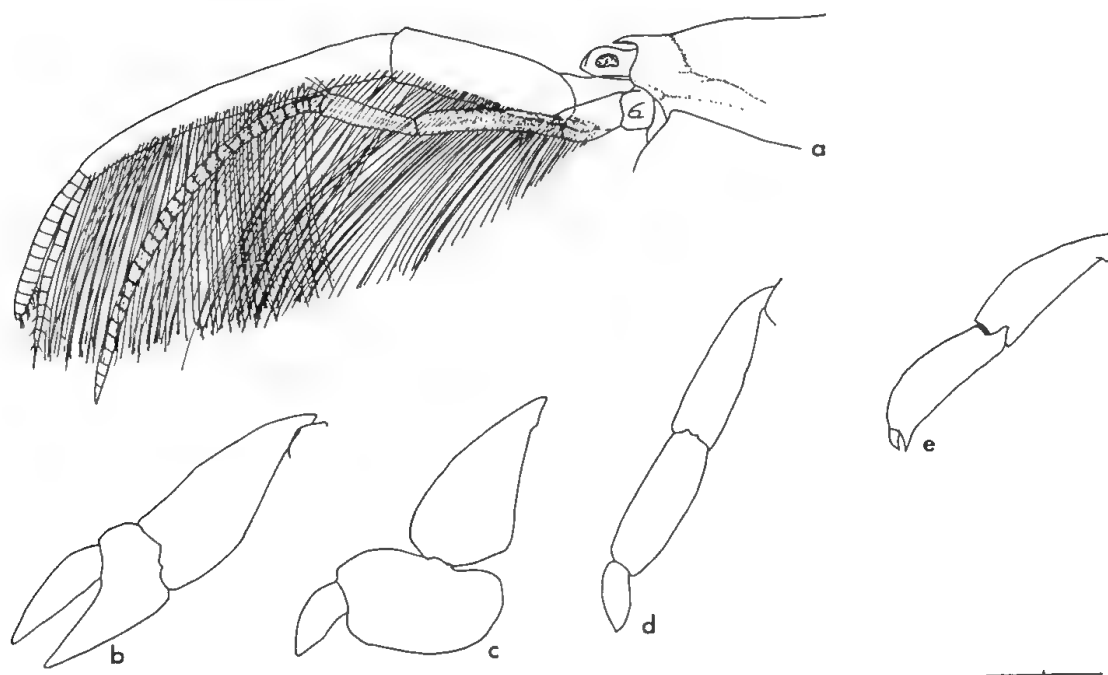


Fig. 19. *Callianassa australiensis* (CPBS stn 25N, female, 32 mm): a, lateral view of anterior region; b-e, pereopods 2-5 (terminal articles only).

DESCRIPTION: Dorsal oval 0.6-0.7 length of dorsal carapace. Rostrum dorsally convex, a very broad triangle, obtuse, 0.2 length of eyestalks; lateral projections broadly obtuse, little shorter than rostrum. Eyestalks broader than long, not reaching distal edge of first article of antenna 1, with broad mesiodistal lobe; pigmented area distal. Peduncle of antenna 1 almost twice as long as that of antenna 2, with a dense curtain of long setae ventrally. Maxilliped 3 merus width 0.6-0.7 length of ischium and merus together, merus as long as ischium; ischium without teeth on inner surface; carpus articulating laterally on merus, distal $\frac{2}{3}$ of merus produced beyond articulation, carpus slender, length 4 times width; propod as long as carpus; dactyl almost half length of propod, tapering. Large cheliped (female) ischium strongly serrate ventrally on distal half, a tooth on dorsal surface proximally; merus with strong ventral serrate hook proximally and serrate ridge on dorsal edge; carpus 0.6-0.7 as wide as long; propod smooth ventrally, fixed finger tapering to upturned end; dactyl barely exceeding fixed finger, tapering to curved end; inner edges of both fingers evenly and coarsely toothed; ratio of dorsal lengths — merus: carpus: propod — 1:0.85-0.95:0.9. Large cheliped (male) carpus 0.8-1.2 times as wide as long; propod as wide as long, deeply incised at gape, a minute mesial denticle close to base of dactyl; dactyl slender, exceeding fixed finger, with a triangular tooth proximally, cutting edge with small teeth, tip strongly curved; ratio of dorsal lengths — merus: carpus: propod — 1:0.7-0.75:1.0-1.1. Small cheliped ischium smooth; merus usually with a minute ventral tubercle; carpus and propod elongate; dactyl and fixed finger subequal, inner edges minutely toothed. Pleopod 1 (female) uniramous, 2-articulate, second article with small lobe midway along. Pleopod 2 (female) biramous, exopod curved, shorter than 2-articulate endopod. Pleopod 1 (male) uniramous, 2-articulate, distal article apically rounded. Pleopod 2 (male) absent. Telson as wide as long, laterally convex, posterior edge weakly concave medially, setae along posterior margin and in tuft on dorsal surface. Uropod endopod oval, greatest width just beyond midpoint, 1.5 times as long as wide, slightly

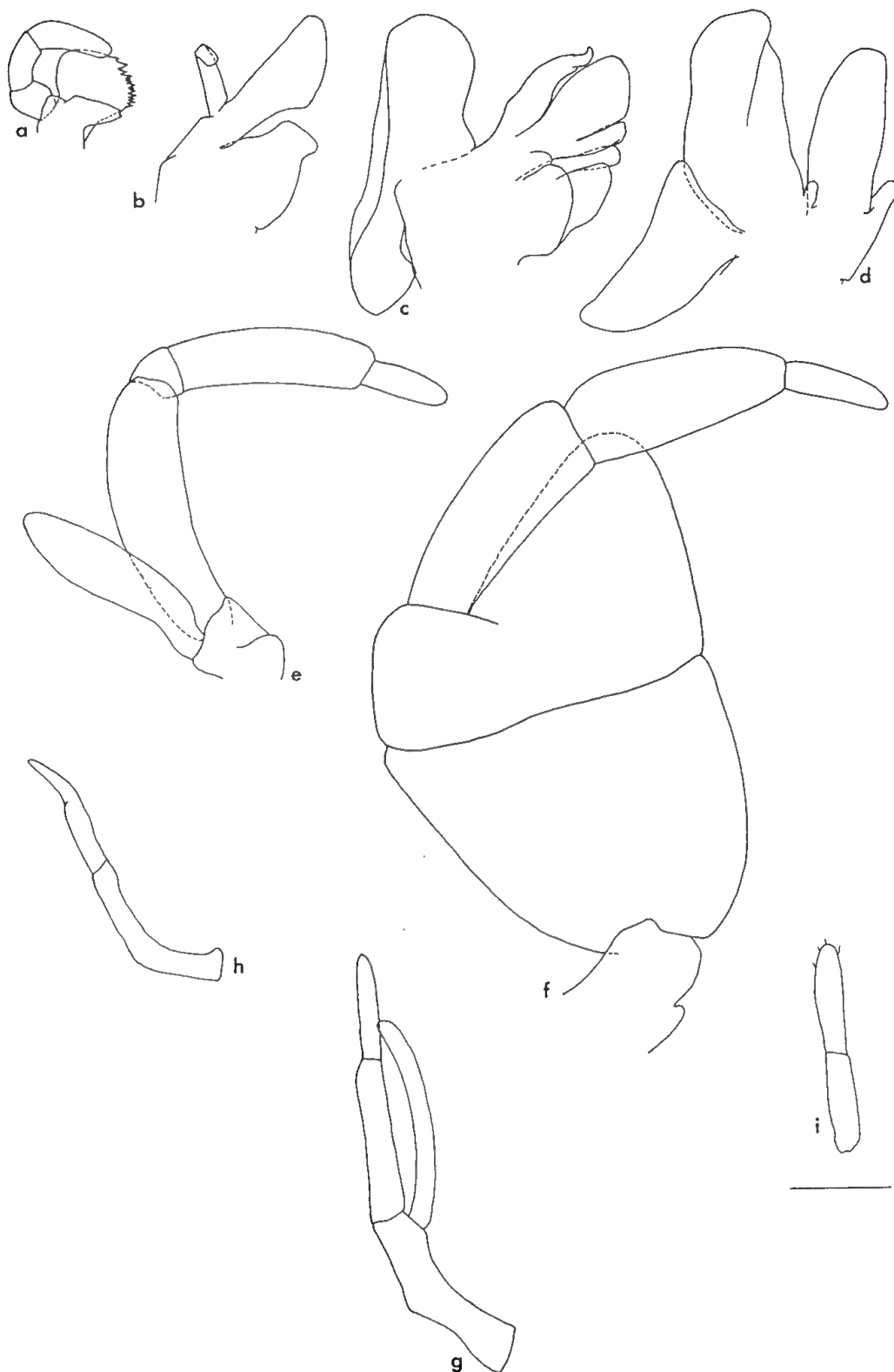


Fig. 20. *Callianassa australiensis* (CPBS stn 25N, female, 32 mm): a, mandible; b, c, maxillae 1, 2; d-f, maxillipeds 1-3; g, h, pleopods 1, 2. (CPBS stn 25N, male, 36 mm): i, pleopod 1.

longer than telson, setose margin; exopod slightly longer than endopod, little shorter than wide, greatest width subdistally, densely setose margin.

DISTRIBUTION: Intertidal sand and mudflats, often in estuarine situations; northern Queensland (Townsville) through N.S.W. and Victoria as far west as Port Phillip Bay.

REMARKS: This species is by far the most abundant thalassinidean in eastern Australia and it is curious that it was omitted from Haswell's (1882) catalogue. It is most easily recognized by the dense setation of the antenna 1 and maxillipeds. In suitable habitats its density reaches many hundreds of individuals per square metre. The ecology of this species was examined by Hailstone & Stephenson (1961). *C. australiensis* is included in *Callianassa* s.s. of de Saint Laurent (1973), but the size of the peduncle of antenna 1 and the shape of maxilliped 3 separate this species from others in the genus. The specimens recorded by Stephenson et al. (1931) from Low Isles, North Queensland (BM(NH) Reg. No. 1937.9.21.405-406) have been re-examined at our request by Dr Ray Ingle (BM(NH)) and confirmed as *C. australiensis*.

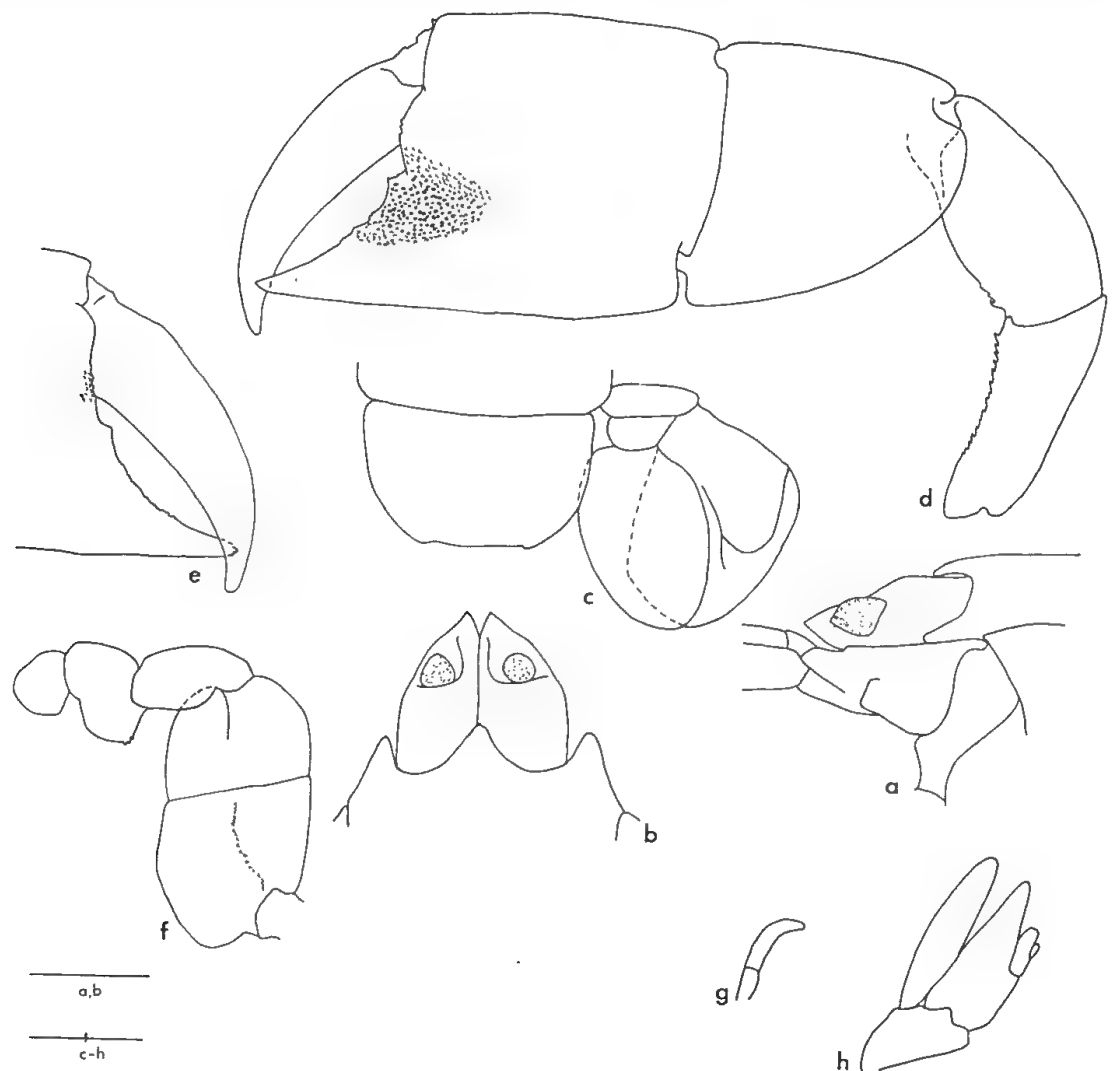


Fig. 21. *Callianassa bulimba* (QM W.1525, male, 36 mm): a, b, lateral and dorsal views of anterior region; c, telson and uropod; d, cheliped (lateral); e, chela (medial); f, maxilliped 3; g, h, pleopods 1, 2.

***Callianassa bulimba* n. sp.**

Fig. 21.

MATERIAL EXAMINED: 1 spec.

HOLOTYPE: QM W.1525, male, tl. 36 mm.

TYPE LOCALITY: *Queensland*: Mud Is., Moreton Bay, collected V. F. Collin, 6th October, 1942.

DESCRIPTION: Dorsal oval 0.8 length of dorsal carapace. Rostrum not depressed, as long as broad, triangular, sharp, one third length of eyestalks; lateral projections strong, equal to rostrum; postrostral area smooth. Eyestalks about as long as first article of antenna 1, anteromedial angle sharp; eye subterminal. Peduncle of antenna 1 reaching to midpoint of last article of antenna 2. Maxilliped 3 merus width half length of ischium and merus together, merus shorter than ischium; ischium with mesial row of many small teeth; carpus articulating terminally on merus; propod medially lobed, lobe with 3 proximal teeth on medial margin, width almost twice length; dactyl width half that of propod, ovate. Chelipeds (presumed) equal; ischium serrate ventrally, teeth stronger distally; merus with curved ventral margin bearing a small proximal spine; carpus little wider than long; propod fixed finger stout with a strong granulate depression proximally on the lateral surface, a small tooth on cutting edge adjacent to dactyl; dactyl longer than fixed finger, unarmed; ratio of dorsal lengths — merus: carpus: propod — 1:1:1.2. Pleopod 1 (male) uniramous, 2-articulate. Pleopod 2 (male) biramous, exopod equal to endopod; endopod 3-articulate, first and second articles lobed, first greatly exceeding second, third article small. Telson widest on proximal margin, distal margin with few setae laterally, dorsally smooth except for few setae at midpoint, length 0.6 greatest width. Uropod endopod ovate, 1.5 times as long as wide, more than 1.5 times as long as telson, sparsely setose marginally; exopod equal to endopod, length 1.3 times width.

DISTRIBUTION: Southern Queensland.

REMARKS: This species is closely related to *C. aequimana* common in southern Australia. Although the general form of the antennae, rostrum, maxilliped 3, chelae and male pleopods are similar in the two species, sufficient differences exist, especially in the eyes, propod of the maxilliped 3, telson and male pleopod 2 to separate this specimen from *C. aequimana*.

***Callianassa ceramica* Fulton & Grant**

Figs 22, 23

Callianassa ceramica Fulton & Grant, 1906: 12-14, pl. 5 (type locality: Port Phillip and Western Port, Victoria). — Hale, 1927: 86. — De Man, 1928a: 27, 104. — Poore, 1975: 205.

MATERIAL EXAMINED: 80 specs; tl. 16-80 mm.

Victoria: Williamstown (NMV Kane colln) 3 specs. — Shoreham, (NMV Fulton collns) 24 specs; (AM P.20163) 2 specs; (AM G.5779) 4 specs; (AM P.25296) 3 specs. — Queenscliff (NMV Batchelor colln) 1 spec.; (NMV Flatow colln) 1 spec. — Sorrento (NMV) 3 specs. — Altona (NMV Brazenor colln) 3 specs. — Point Lonsdale (NMV) 1 spec. — Point Addis (AM P.13155) 1 spec. — San Remo Ocean Beach (NMV Blackwood colln) 4 specs. — Portland (NMV Buther colln) 8 specs. — Port Phillip Bay or Western Port mudflats — cotype (AM G.5666) 1 spec. — Tidal R., Wilsons Promontory (NMV Kudenov colln) 1 spec.

Tasmania: Koonya, Tasman Peninsula (TM G.1582) 2 specs. — Cowry Pt (TM G.393) 2

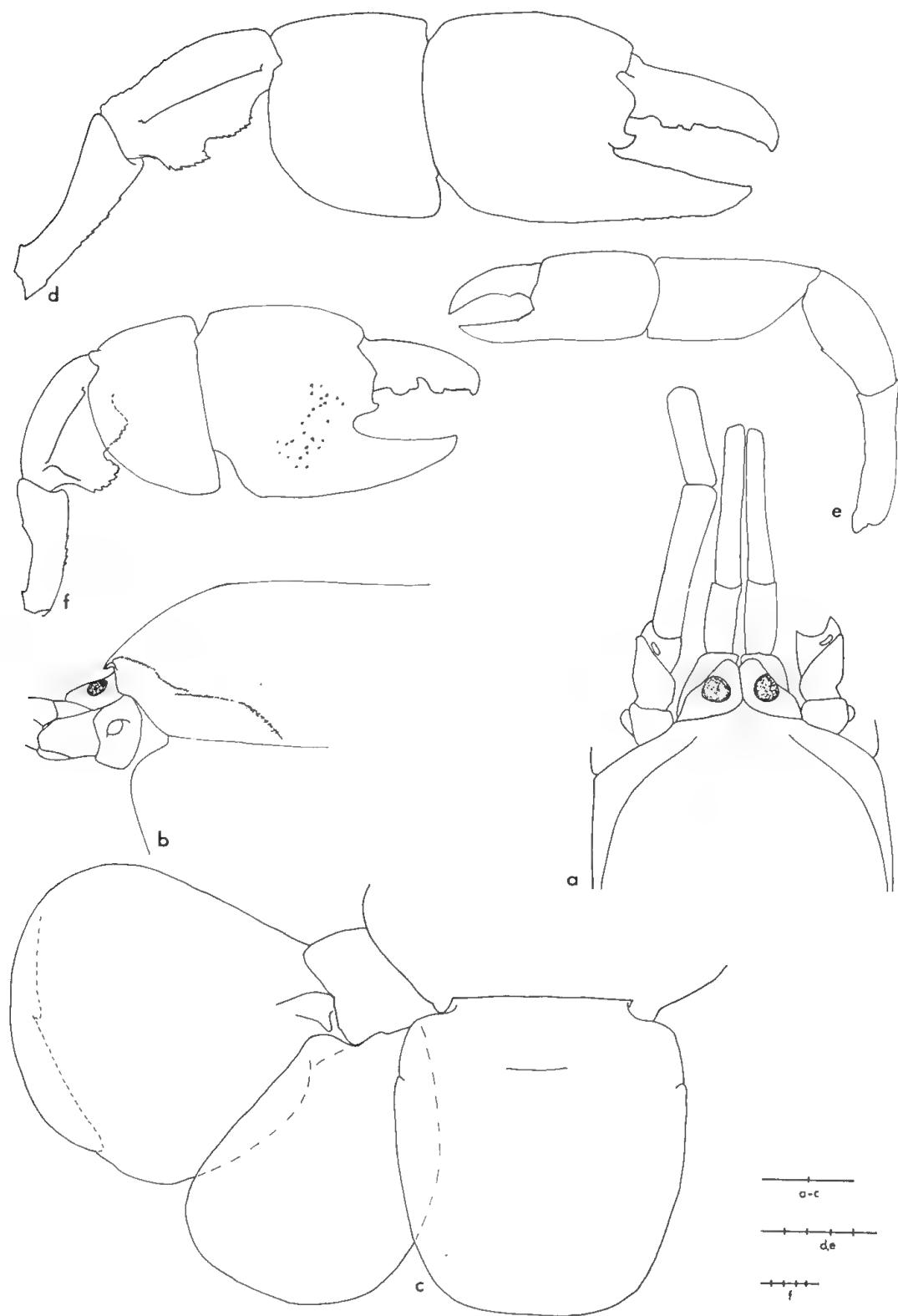


Fig. 22. *Callianassa ceramica* (NMV Fulton colln, female, 63 mm): a, b, dorsal and lateral views of anterior region; c, telson and uropod; d, large cheliped; e, small cheliped. (NMV Fulton colln, male, 60 mm): f, large cheliped.

specs.; (TM G.394) 10 specs. — Triabunna (TM G.1298) 1 spec.

South Australia: Kangaroo Is. (AM P.5778) 1 spec.

Western Australia: Miami Beach, Mandurah (WAM 33-75) 1 spec. — Esperance (WAM 64-75) 1 spec. — Peaceful Bay (WAM 13-75) 2 specs.

DESCRIPTION: Dorsal oval 0.8-0.9 length of dorsal carapace. Rostrum strongly downturned, broad to very obtuse, apically slender and pointed, less than 0.2 length of eyestalks; lateral projections obsolete. Eyestalks extending almost to end of first article of antenna 1, with minute, often sharp, mesiodistal spine; pigmented area large, subcircular, central. Peduncle of antenna 1 reaching midway along last article of antenna 2; neither antenna very setose. Maxilliped 3 merus width 0.6-0.7 length of ischium and merus together, merus little shorter than ischium; ischium with curved row of 12-22 spines along midline of inner surface; carpus articulating distolaterally on merus, broadened distally; propod tapering, without lobe, half as wide as long; dactyl narrow, half as wide as propod, tapering. Large cheliped (female) ischium serrate midventrally and with proximal dorsal

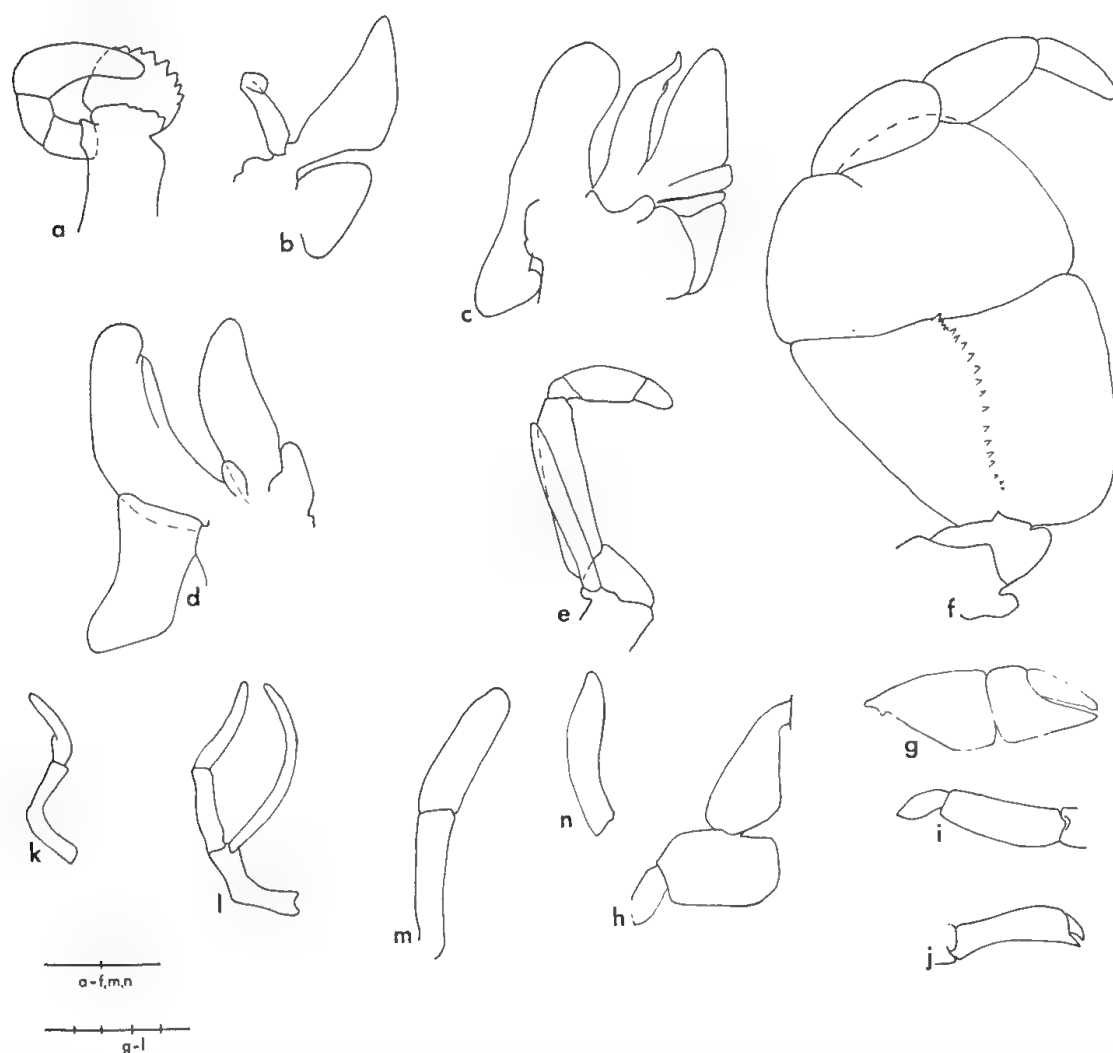


Fig. 23. *Callianassa ceramica* (NMV Fulton colln, female, 63 mm): a, mandible; b, c, maxillae 1, 2; d-f, maxillipeds 1-3; g-j, pereopods 2-5 (terminal articles only); k, l, pleopods 1, 2. (NMV Fulton colln, male, 60 mm): m, n, pleopods 1, 2.

tooth; merus bilobed ventrally, lobes strongly serrate, dorsal ridge also serrate, a longitudinal ridge laterally; carpus about 1.3 times as wide as long, dorsally and ventrally smooth; propod finely crenulate ventrally; gape with strong serrate tooth; fixed finger tapering to upturned end, cutting edge minutely serrate proximally; dactyl equal to fixed finger, tapering to curved end, a prominent, truncate serrate tooth close to base and sometimes another midway along, middle third to distal half of cutting edge denticulate; ratio of dorsal lengths — merus: carpus: propod — 1:1.2-1.3:0.8-1.0. Large cheliped (male) of similar form to that of female except that carpus and propod are shorter, chela more gaping and cutting edge of dactyl with pronounced notch at midpoint. Small cheliped ischium smooth; merus usually with small ventral spine or hook; carpus elongate; dactyl slightly over-reaching fixed finger, ventral edge with blunt triangular tooth proximally. Pleopod 1 (female) uniramous, 2-articulate, second article with lobe midway along, distal portion flat and curved posteriorly. Pleopod 2 (female) biramous, exopod curved, subequal to 2-articulate endopod. Pleopod 1 (male) uniramous, 2-articulate. Pleopod 2 (male) uniramous, narrow, but often absent. Telson as wide as long, lateral edges weakly convex, posterior edge weakly convex; long setae along posterior edge and in tuft on dorsal surface. Uropod endopod subovate, lateral margin straight, medial and distal edges weakly convex, continuous, greatest width at distal third, almost as wide as long, a little longer than telson, with setose margin; exopod longer than endopod, width slightly exceeding length, widest distally, with setose margin.

DISTRIBUTION: Intertidal and shallow subtidal mudflats and sandy beaches; Tasmania, Victoria, South Australia, south Western Australia.

REMARKS: Fulton & Grant (1906) did not note any sexual differentiation in their material. Their illustration is of a female and consequently their description misses some points on the dentition of the male cheliped. The species is fairly consistent and is often best recognized by the subquadrate propod on pereopod 3. *C. ceramica* could be included in *Callianassa* s.s. of de Saint Laurent (1973) except that the male pleopods are scarcely rudimentary.

***Callianassa collaroy* n. sp.**

Figs 24, 25

MATERIAL EXAMINED: 2 males, 1 female; tl. 45-123 mm.

HOLOTYPE: AM P.16305, male, 45 mm.

TYPE LOCALITY: *New South Wales:* Long Reef, Collaroy, in sand among boulders, coll. I. Bennett, 9th December, 1946.

PARATYPES: *New South Wales:* Long Reef, Collaroy (AM P.13163) 1 spec. — Shellharbour (AM P.8869) 1 spec.

DESCRIPTION: Dorsal oval 0.8 length of dorsal carapace. Rostrum an anteriorly-directed, acute spine as long as eyestalk, articulating in smaller specimens. Lateral projections acute, half as long as rostrum. Eyestalks shorter than first article of antenna 1; eyes large, terminal. Peduncle of antenna 1 reaching to about midpoint of peduncle of antenna 2. Antenna 2 with dorsal spine on distal edge of article 3. Maxilliped 3 merus width about 0.75 length of ischium and merus together, merus little shorter than ischium; ischium with 13-17 stout teeth mesially; with a small tooth on distal margin, carpus articulating distolaterally on merus; propod as wide as long, subquadrate; dactyl a quarter as wide as propod, half as long. Large cheliped (both sexes) coxa with strong medial ventrally-directed hook; ischium with 4-5 strong ventral spines; merus with 3-5 sharp ventral spines; carpus 0.8 times as wide as long; propod smooth

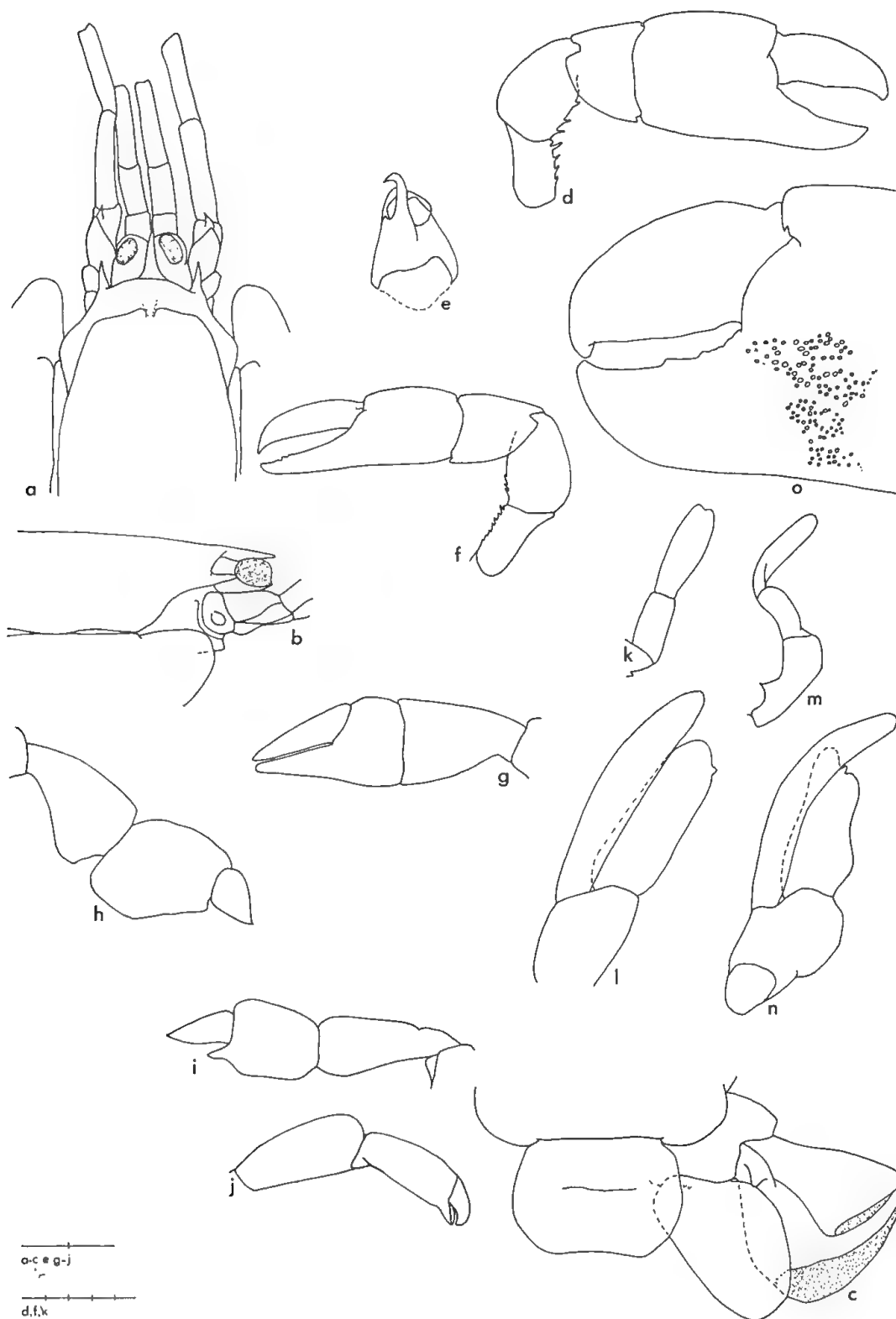


Fig. 24. *Callinassa collaroy* (AM P.16305, male, 52 mm): a, b, dorsal and lateral views of anterior region; c, telson and uropod; d, large cheliped; e, medial view of coxa of left cheliped; f, small cheliped; g-j, pereopods 2-5 (terminal articles only); k, l, pleopods 1, 2. (AM P.13163, female, 123 mm): m, n, pleopods 1, 2. (AM P.8869, female, 101 mm): o, chela.

dorsally and ventrally but minutely denticulate near gape on medial and lateral surfaces of large specimen; fixed finger with obsolete irregularly-toothed ridge on proximal half of cutting edge; dactyl stout, little longer than fixed finger, with a sharply-curved terminal tooth, and cutting edge slightly concave; ratio of dorsal lengths — merus: carpus: propod — 1:0.9:1.2. Small cheliped ischium and merus with ventral spines; carpus and propod elongate; fixed finger with small subterminal tooth. Pleopod 1 (female) uniramous, 2-articulate, second article medially-lobed, distal portion curved posteriorly. Pleopod 2 (female) biramous, exopod longer than broad, terminally notched endopod. Pleopod 1 (male) uniramous, 2-articulate, distal article broad, notched terminally. Pleopod 2 (male) biramous, exopod longer than broad endopod. Telson 1.5 times as wide as long, apically excavate; laterally convex; a transverse row of short spines with longer setae near midpoint of the dorsal surface; small groups of long setae at distolateral corners. Uropod endopod with inner margin almost straight, greatest width near midpoint and tapering to a broadly rounded apex, extending almost twice length of telson, setae only near apex and in two small groups on dorsal surface; exopod as long as endopod, subtriangular, wider than long, terminally very setose.

DISTRIBUTION: Intertidal, in sand among boulders; central New South Wales.

REMARKS: This species is particularly close to the Hawaiian *Callianassa articulata* Rathbun, 1906, but comparison with the original figures and Edmondson's (1944) illustrations reveal several distinguishing features. The two species share a trispined front, a terminal spine on article 3 of antenna 2, a terminal hook on the merus of maxilliped 3 and a short telson broadest at its midpoint. *C. collaroy* differs in having a straight rather than

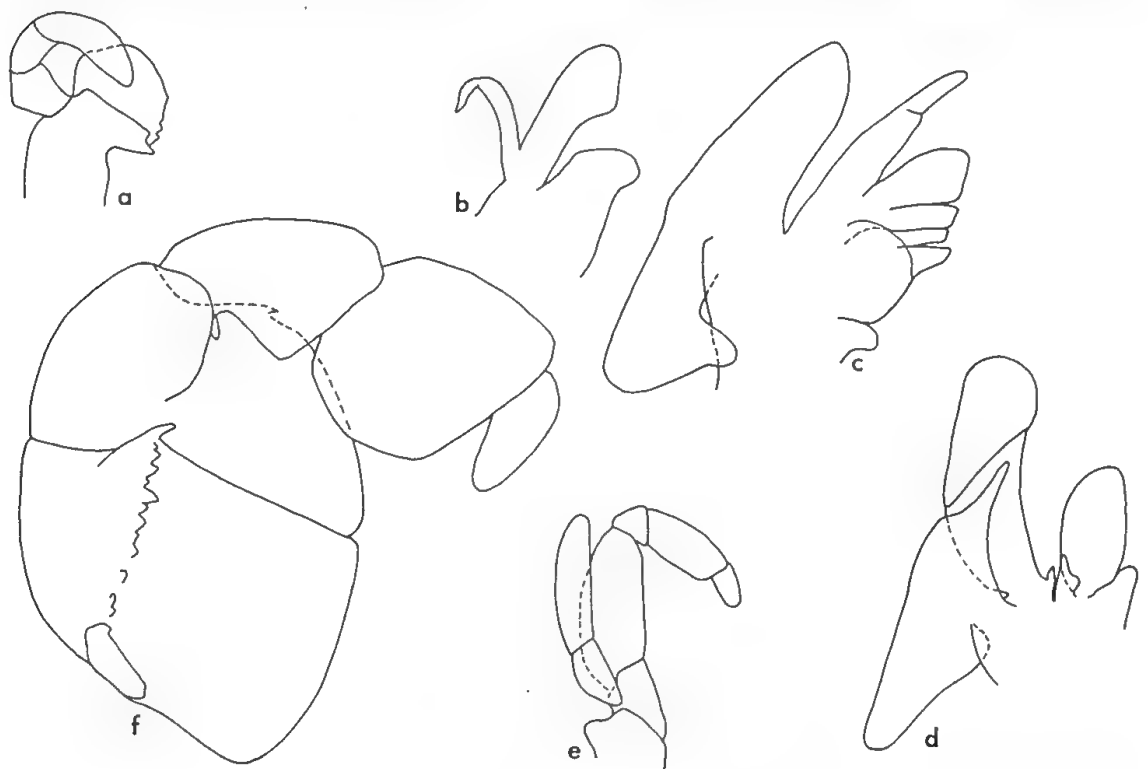


Fig. 25. *Callianassa collaroy* (AM P.16305, male, 52 mm): a, mandible; b, c, maxillae 1, 2; d-f, maxillipeds 1-3.

curved rostrum, a broader and larger propod on maxilliped 3, a tooth on the fixed finger of the small cheliped and more ovate rami on the uropods. The largest specimen of *C. articulata* known (33 mm) is less than a third the size of the largest *C. collaroy* in our collection.

Callianassa collaroy is most easily separated from the only other trispined species from Australia (*C. haswelli*) by the form of the telson and uropods.

***Callianassa haswelli* n. sp.**

Figs 26, 27

Callianassa sp. Haswell, 1882: 167-168.

MATERIAL EXAMINED: 2 males, 3 females; tl. 32-65 mm.

HOLOTYPE: AM P.11453, female, tl. 65 mm.

TYPE LOCALITY: *Queensland*: Whitsunday Group, coll. Mrs R. Hallam.

PARATYPES: *Queensland*: Yam Is., Torres Strait (AM P.24814) 1 spec. — Molle Is., Whitsunday Passage (AM P.274) 1 spec. (the specimen referred to by Haswell, 1882). — Masthead Is., Capricorn Group (NMV Kershaw colln) 1 spec. — Langford Is., Cumberland Group (AM P.20833) 1 spec.

DESCRIPTION: Dorsal oval 0.8 length of dorsal carapace. Rostrum a broadly-based upturned acute spine about as long as eyestalk, non-articulating. Lateral projections also upwardly-directed, acute spines, less than half length of rostrum. Eyestalks shorter than first article of antenna 1; eyes large, terminal. Peduncle of antenna 1 just exceeding article 4 of antenna 2. Maxilliped 3 merus width half length of ischium and merus together, merus little shorter than ischium; ischium with 12-16 uneven teeth mesially; carpus articulating distolaterally on merus; propod as wide as long, bigger than merus, free distal margin transverse and excavate; dactyl one third as wide as propod and as long. Large cheliped (both sexes) ischium with a few blunt ventral teeth; merus with a ventral ridge of blunt spines, more definite proximally; carpus 1.3 times as wide as long; propod smooth dorsally and ventrally; fixed finger with an obsolete basal tooth; dactyl stout, longer than fixed finger, with sharply curved terminal tooth and obsolete basal tooth; ratio of dorsal lengths — merus: carpus: propod — 1:0.75:1.3. Small cheliped ischium and merus without ventral spines; carpus and propod elongate; fixed finger with small, blunt tooth at midpoint of cutting edge. Pleopod 1 (female) uniramous, second article medially lobed. Pleopod 2 (female) biramous, exopod longer than endopod which is notched terminally. Pleopod 1 (male) 2-articulate, second article broad, with strong terminal hook. Pleopod 2 (male) biramous, exopod little longer than endopod. Telson 1.7 times as wide as long; widest basally and tapering to sinuate posterior margin; dorsal surface convex, with one pair of tufts of long setae; small groups of setae on distolateral corners. Uropod endopod lanceolate, more than twice length of telson, setae only in small groups on dorsal surface; exopod almost twice length of endopod, medial edge concave, produced.

DISTRIBUTION: Islands off north and central Queensland coast.

REMARKS: *C. haswelli* is superficially similar to *C. collaroy* from N.S.W. in having a trispined front to the carapace but is readily distinguished by the upturned rostral spine and the different form of the telson and uropods. Of other trispined species it resembles *C. longiventris* most closely (Biffar, 1971a), differing in the absence of strong spines on the chelipeds and form of the telson and uropod. It is also similar to *C. lanceolata* Edmondson, 1944, from Hawaii, and *C. nakesonei* Sakai, 1967, from Okinawa, Ryukyu Islands, differing



Fig. 26. *Callianassa haswelli* (AM P.11453, female, 65 mm): a, b, dorsal and lateral views of anterior region; c, large cheliped; d, small cheliped. (NMV Kershaw colln, female, 32 mm): e, telson and uropod.

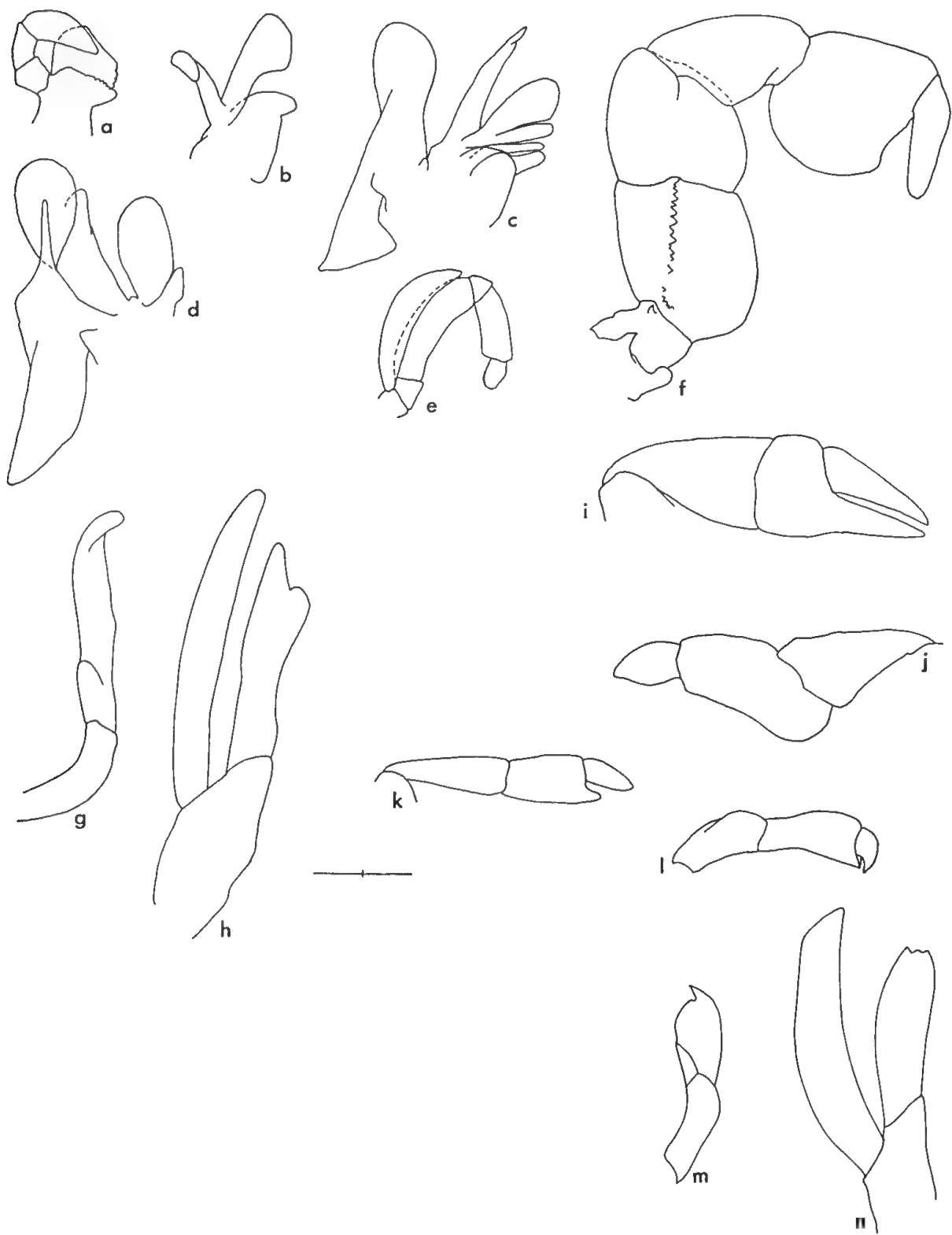


Fig. 27. *Callianassa haswelli* (AM P.11453, female, 65 mm): a, mandible; b, c, maxillae 1, 2; d-f, maxillipeds 1-3; g, h, pleopods 1, 2. (AM P.274, female): i, j, pereopods 2, 3 (terminal articles only). (NMV Kershaw colln, female, 32 mm): k, l, pereopods 4, 5 (terminal articles only). (AM P.20833, male, 65 mm): m, n, pleopods 1, 2.

in the uropods and maxilliped 3 among other features. This species is named for W. A. Haswell (1854-1925), a pioneer in the study of Australian Crustacea.

***Callianassa jocularix* De Man**

Figs 28, 29

Callianassa jocularix De Man, 1905: 610 (type localities: Indonesia: Java, Lombok, Sumbawa, Flores Strait, Sulawesi, Kai Islands); 1928a: 26, 98, 130-137, pl. 12 fig. 19b, c, pl. 13 figs 19a, d-m. — McNeill, 1968:26.

MATERIAL EXAMINED: 4 males, 2 females; tl. 14 mm, all with chelipeds detached.

Queensland: W. of Low Isles (British Great Barrier Reef Expedition 1928-29) (AM P.15009) 6 specs.

DESCRIPTION: Dorsal oval 0.8 length of dorsal carapace. Rostrum a narrow acute forward-directed spine, about half length of eyestalks. Lateral projections obscure. Eyestalks just exceeding first article of antenna 1; dorsoventrally tapering from basal eye, distal half broad, but with an acute distal spine medially. Peduncle of antenna 1 longer than that of antenna 2. Maxilliped 3 merus width $\frac{1}{4}$ length of merus and ischium together, merus shorter than slightly tapering ischium; ischium with a row of 8-10 teeth mesially; carpus articulating terminally on merus; propod little broader than carpus, tapering; dactyl half as wide as propod, tapering. Large cheliped (female) ischium with a few ventral spines; merus with a straight dorsal margin bearing 1-2 small proximal hooks or spines, a strong sharp spine opposite on the straight ventral margin; carpus 0.75 times as wide as long; propod smooth dorsally and ventrally; fixed finger and dactyl equal, evenly tapered, cutting edges minutely serrate; dactyl curved distally; ratio of dorsal lengths — merus: carpus: propod — 1:1:0.8. Large cheliped (male) ischium and merus as for female; carpus 1.5 times as broad as long; propod with a dorsal ridge; fixed finger short and stout, cutting edge sinuate, gape a little excavate; dactyl stout, strongly curved with a subterminal tooth on cutting edge; ratio of dorsal lengths — merus: carpus: propod — 1:0.7:1.2. Small cheliped extremely fine and elongate, ischium with 1-2 ventral teeth. Pleopod 1 (female) uniramous, second article broad. Pleopod 2 (female) biramous, exopod 2-articulate. Pleopod 1 (male) a prominent conical lobe. Pleopod 2 (male) absent. Telson 1.5 times as wide as long; widest $\frac{1}{3}$ way along and tapering to nearly straight posterior margin. Uropod endopod longer than telson, lateral and medial margins diverging to evenly rounded end; exopod longer than endopod, with straight lateral margin, long curved posterior margin continuous with convex medial margin.

DISTRIBUTION: Mud, 15-350 m; Indonesia, northern Queensland.

REMARKS: This species has been well described and illustrated previously by De Man (1928a) and our specimens agree.

***Callianassa karumba* n. sp.**

Figs 30, 31

MATERIAL EXAMINED: 1 spec.

HOLOTYPE: AM P.24678, male, tl. 34 mm.

TYPE LOCALITY: *Queensland*: Norman River, Karumba; CSIRO Gulf of Carpentaria Prawn Survey, beam trawl collection, 10th February, 1964.

DESCRIPTION: Dorsal oval 0.7 length of carapace. Rostrum a slightly upturned acute spine, about half length of eyestalks; lateral projections obsolete. Eyestalks extending

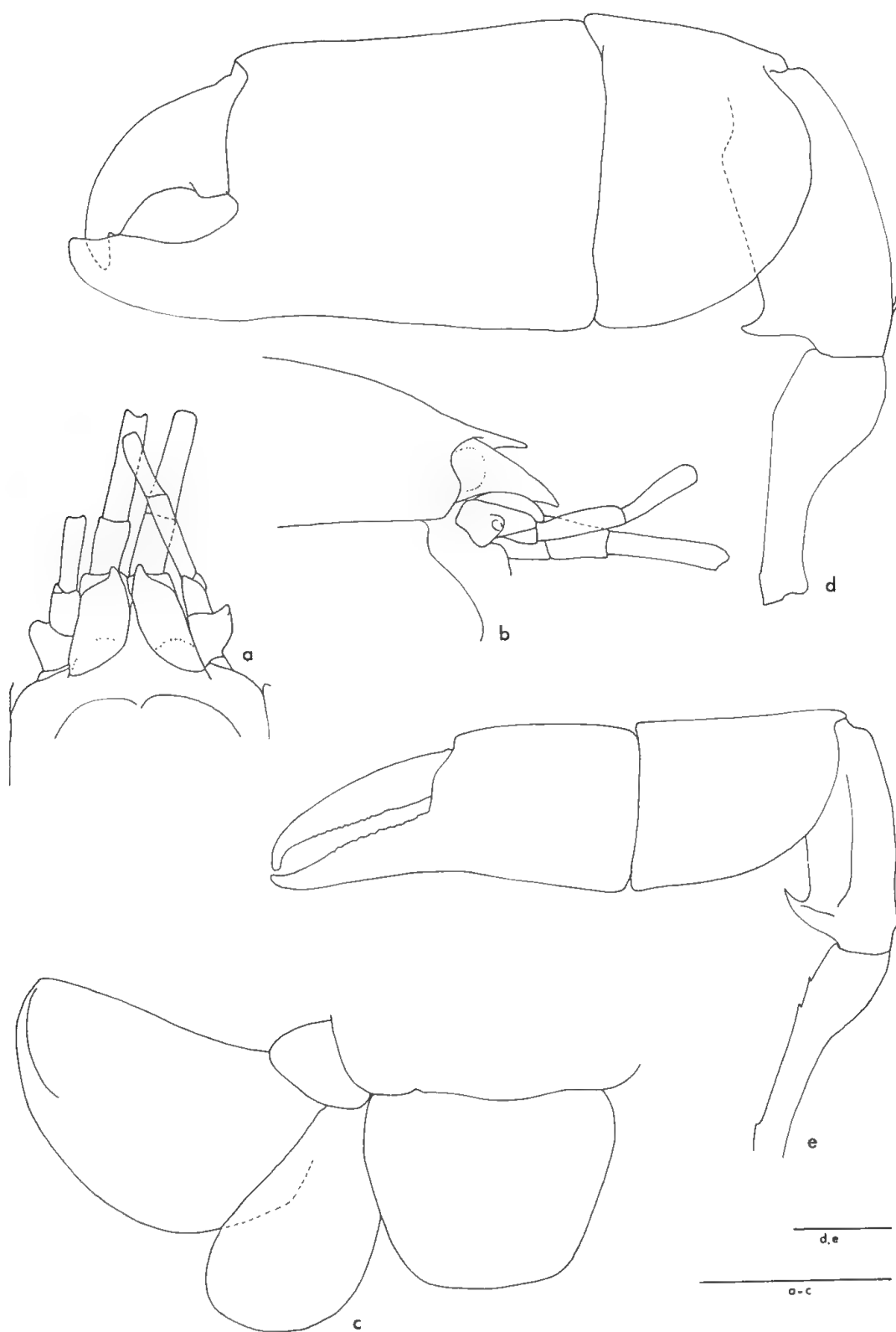


Fig. 28. *Callianassa joculatrix* (AM P.15009, male, 14 mm): a, b, dorsal and lateral views of anterior region; c, telson and uropod; d, large cheliped. (AM P.15009, female, 14 mm): e, large cheliped.

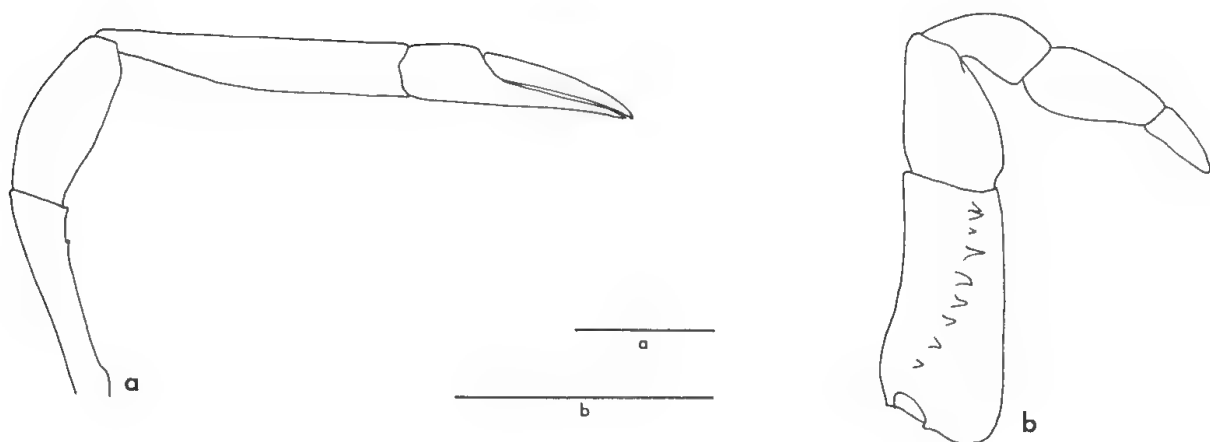


Fig. 29. *Callianassa joculatrix* (AM P.15009, male, 14 mm): a, small cheliped; b, maxilliped 3.

beyond end of first article of antenna 1, a rounded lobe mediodistally; eyes large central-subdistal. Peduncle of antenna 1 reaching almost to end of that of antenna 2; neither antenna particularly setose. Maxilliped 3 with a minute exopod, about 0.2 length of ischium of endopod; merus width about half of length of ischium and merus together, merus 0.7 length of ischium; ischium with few minute denticles proximally on inner surface; carpus articulating distally on merus; propod strongly lobed mesially, as wide as long; dactyl narrow, 0.3 width of propod and reaching back almost to base of ischium. Large cheliped (male) ischium denticulate ventrally; merus irregularly spinose ventrally; carpus about 1.3 times as wide as long, dorsally and ventrally smooth; propod obscurely denticulate ventrally; gape with a double blunt accessory tooth; fixed finger unarmed; dactyl equal to fixed finger, tapering to a curved end, cutting edge smooth; ratio of dorsal lengths — merus: carpus: propod — 1:0.8:1.0. Large cheliped (female) unknown. Small cheliped with elongate carpus; dactyl slightly over-reaching fixed finger which bears minute spines on cutting edge. Pleopod 1 (male) 2-articulate, second article terminally notched. Pleopod 2 (male) biramous; endopod 2-articulate, shorter than exopod, second article small and with a mesiodistal digitate lobe. Pleopods (female) unknown. Telson length 0.7 times width, lateral and posterior margins convex. Uropod endopod lanceolate, greatest width at proximal third, width half length, almost twice length of telson; exopod longer than endopod, width almost twice length, widest at midpoint.

DISTRIBUTION: Queensland (Norman River, Karumba, Gulf of Carpentaria).

REMARKS: This species is distinguished by the presence of a minute exopod on maxilliped 3, a feature noted for, *C. tooradin*, *C. novaebritanniae* (see Sakai, 1966) and *C. latispina* (see Biffar, 1971a) in all of which the exopod is a much larger ramus. *C. karumba* bears little resemblance in other features to these species except *C. novaebritanniae* from which it is easily distinguished by the rostrum, telson and uropods. *C. karumba* is most similar to two species, *C. mucronata* Strahl, 1861, from Australia and *C. placida* De Man, 1905, from Indonesia resembling them in general form of the uropods, telson and chelipeds. It differs, however, in the single spined rostrum, lanceolate uropod endopod and very long exopod among many other features.

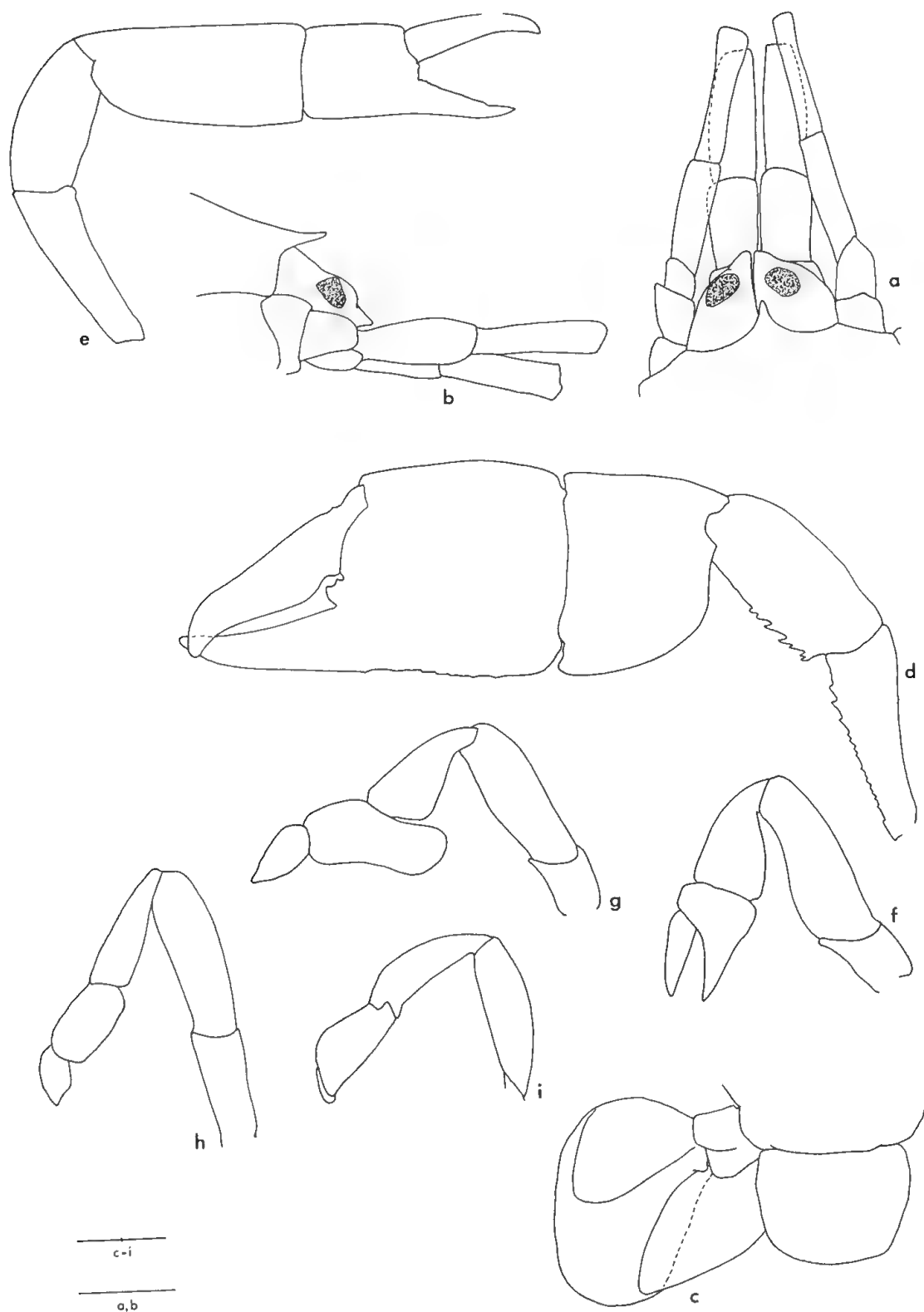


Fig. 30. *Callianassa karumba* (AM P.24678, male, 34 mm): *a, b*, dorsal and lateral views of anterior region; *c*, telson and uropod; *d*, large cheliped; *e*, small cheliped; *f-i*, pereopod 2-5.

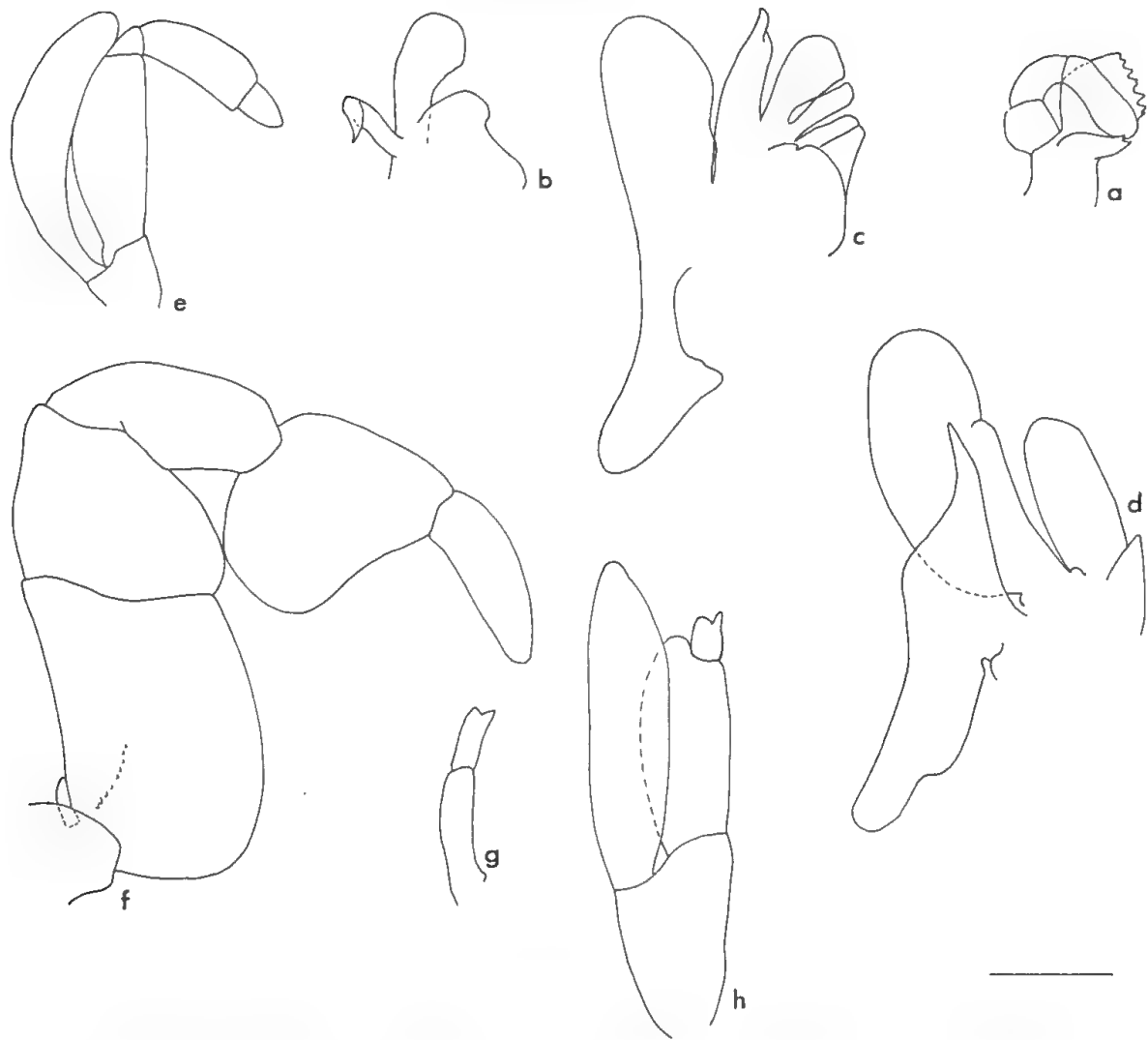


Fig. 31. *Callianassa karumba* (AM P.24678, male, 34 mm): a, mandible; b, c, maxillae 1, 2; d-f, maxillipeds 1-3; g, h, pleopods 1, 2.

***Callianassa limosa* Poore**
Figs 32, 33

Callianassa limosa Poore, 1975: 201-205, figs 4, 5 (type locality: Victoria, Port Phillip Bay).

MATERIAL EXAMINED: 27 specs, tl. 12-19 mm.

New South Wales: 4.5 km E. of North Head, 66 m (AM P.20160) 1 spec.; (AM P.20159) 1 spec.; (AM P.20161) 1 spec.; (AM P.20157) 1 spec. — 2.3 km E. of Malabar, 66 m (AM P.20162) 3 specs; (AM P.20156) 7 specs. — Off Malabar, 75 m (AM P.20158) 2 specs. — Off Cronulla, 73 m (AM P.16257) 1 spec. — 'Illawarra' district (AM P.20165) 7 specs.

Victoria: Hobsons Bay, Port Phillip Bay (NMV) 1 spec.

Tasmania: 5½ m (8.8 km) off Burnie (TM G.1479) 1 spec.

DISTRIBUTION: Deeper (well below low water down to 100 m) muddy shelf and bay sediments; central N.S.W. through central coastal Victoria to Tasmania.

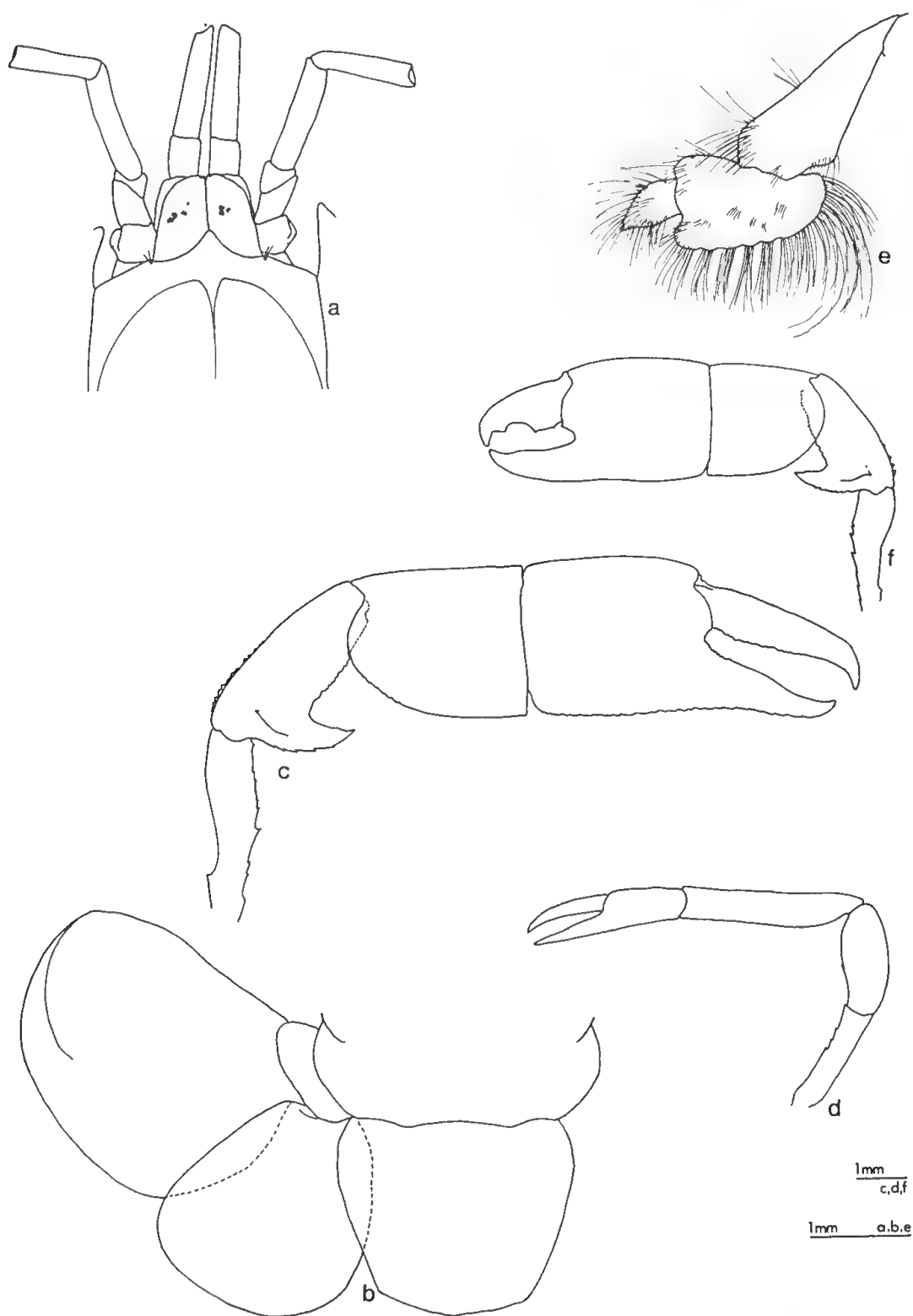


Fig. 32. *Callianassa limosa* (NMV J.274, female, 23 mm (holotype)): a, front; b, tail fan; c, large cheliped (right); d, small cheliped (left); e, pereopod 3. (NMV J.275, male, 14 mm (allotype)): f, large cheliped (left).

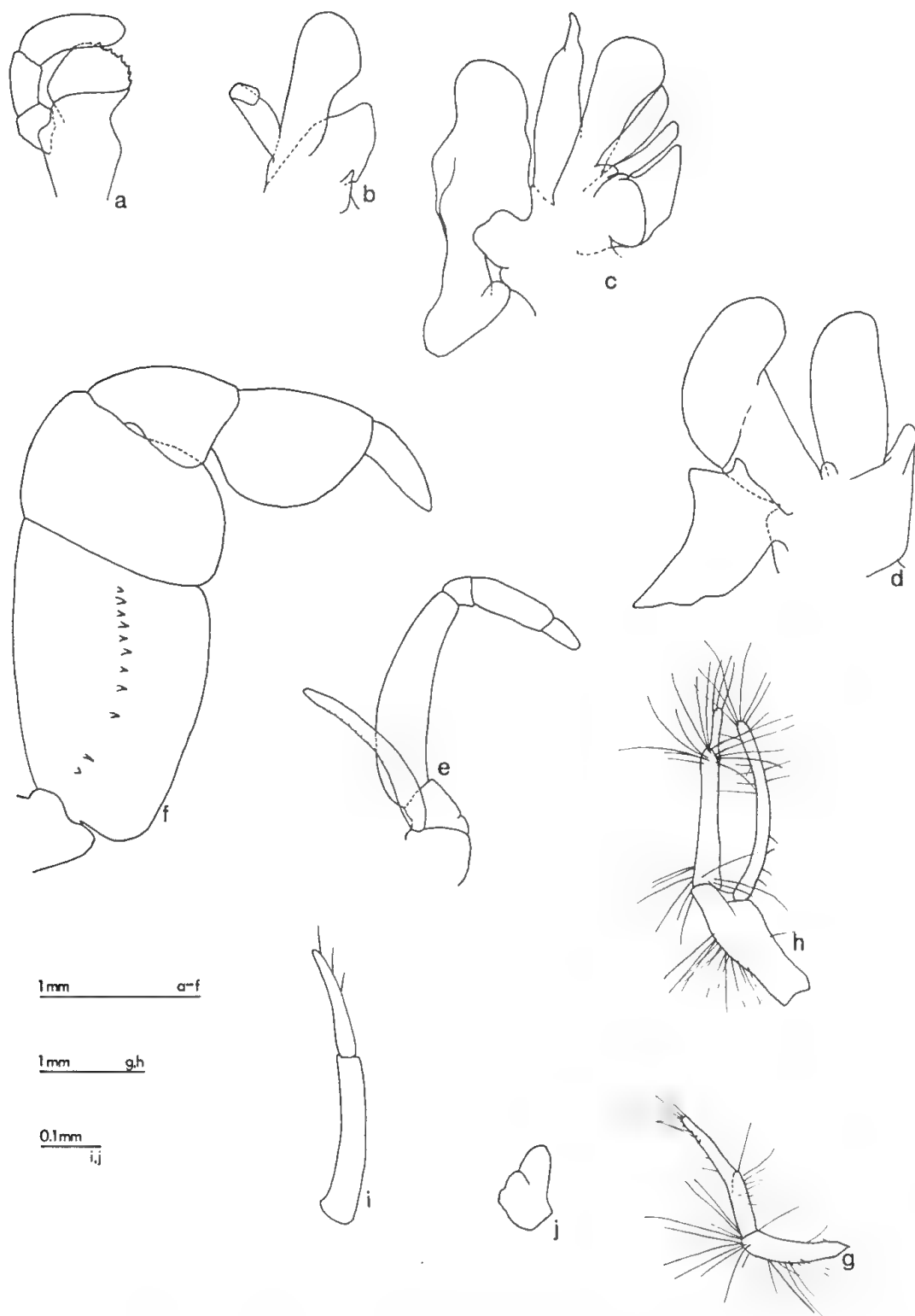


Fig. 33. *Callianassa limosa* (NMV J.274, female, 23 mm (holotype)): a, mandible; b, c, maxillae 1, 2; d-f, maxillipeds 1-2-3; g, h, pleopods 1, 2. (NMV J.275, male, 14 mm (allotype)): i, j, pleopods 1, 2.

REMARKS: In a previous paper (Poore, 1975) the distribution of this species in Port Phillip Bay was discussed and its preference for fine muddy sediments noted. The additional collections reported on here are morphologically similar to the Port Phillip Bay material and extend its distribution through muddy sediments of Bass Strait and the southeastern Australian shelf.

The species is recognized by its small adult size, rudimentary eyes and strongly lobed propod on maxilliped 3. The figures are from Poore (1975).

***Callianassa mucronata* Strahl**

Figs 34, 35

Callianassa mucronata Strahl, 1861: 1056 (type locality: Luzon, Philippine Is.). — De Man, 1887: 484-485, pl. 21 fig. 2; 1928a: 29, 112, 175-179, pl. 19 fig. 30 (for complete synonymy). — Tirmizi, 1977: 21-26, figs 1-3.

Callianassa novaeguineae Thallwitz, 1891: 31.

MATERIAL EXAMINED: 1 male, 1 female; tl. 33-37 mm.

Queensland: Palm Is. (AM P.5194) 1 spec. — Rat Is., Port Curtis (AM P.2010) 1 spec.

DESCRIPTION: Dorsal oval 0.8 length of dorsal carapace. Rostrum a broadly-based, downturned acute triangle less than half length of eyestalks. Lateral projections obsolete angles. Eyestalks little shorter than first article of antenna 1, basally thick and terminally a flat rounded-acute lobe; eye at midpoint. Peduncle of antenna 1 reaching to midpoint of article 5 of antenna 2. Maxilliped 3 merus width 0.4 length of ischium and merus together, merus shorter than ischium; ischium with a row of about 20 teeth mesially; carpus triangular, articulating terminally on merus; propod as wide as long, medial margin evenly curved; dactyl $\frac{1}{3}$ as wide as propod, ovate. Large cheliped (both sexes) ischium with irregular spines on ventral margin; merus with an irregularly serrate ventral margin, convex dorsal margin; carpus little wider than long, ventral margin ending distally with a small tooth; propod smooth dorsally and ventrally; fixed finger stout, with blunt tooth at midpoint; dactyl as long or longer than fixed finger, cutting edge with strong notch near midpoint, hooked terminally; ratio of dorsal lengths — merus: carpus: propod — 1:0.8:1.5. Small cheliped ischium and merus unarmed; carpus, propod and fingers elongate. Pleopod 1 (female) uniramous, second article longer, curved. Pleopod 2 (female) biramous, exopod longer than 2-articulate endopod, second article small, articulating laterally. Pleopod 1 (male) a single flat elongate article, unevenly notched distally. Pleopod 2 (male) biramous, exopod shorter than broad, terminally notched endopod. Telson 1.5 times as wide as long; widest proximally and tapering to evenly convex posterior margin; dorsal surface and posterior margin with a few tufts of setae. Uropod endopod ovate-lanceolate, almost twice length of telson; exopod as long as endopod, broadly ovate.

DISTRIBUTION: Coral reef; various localities in Indonesia, Papua New Guinea and northern Queensland. The present specimens represent the first records of this species from Australia.

REMARKS: Our specimens agree substantially with earlier descriptions of this species except that De Man (1887, 1928a) has described and figured the rostrum as spiniform. This character is variable in other species and not sufficient to distinguish Australian material. We believe De Man (1928a: fig. 30d) was in error in describing the male pleopod 1 as 2-articulate. *C. mucronata* is distinguished from other Australian callianassids by the combination of tapering telson and short rostrum and by its characteristic maxilliped 3 and chela.

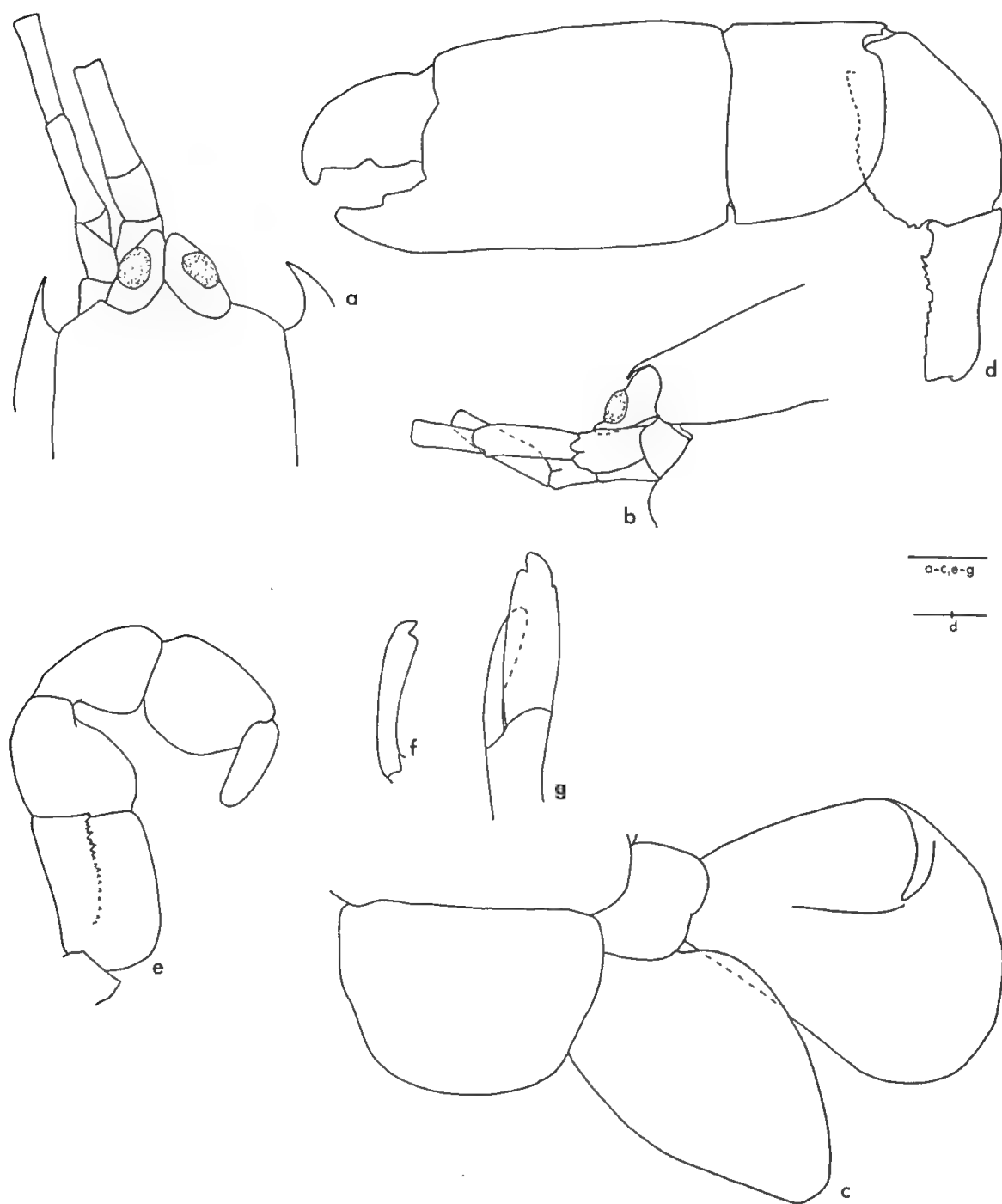


Fig. 34. *Callianassa mucronata* (AM P.2010, male, 33 mm): a, b, dorsal and lateral views of anterior region; c, telson and uropod; d, large cheliped; e, maxilliped 3; f, g, pleopods 1, 2.

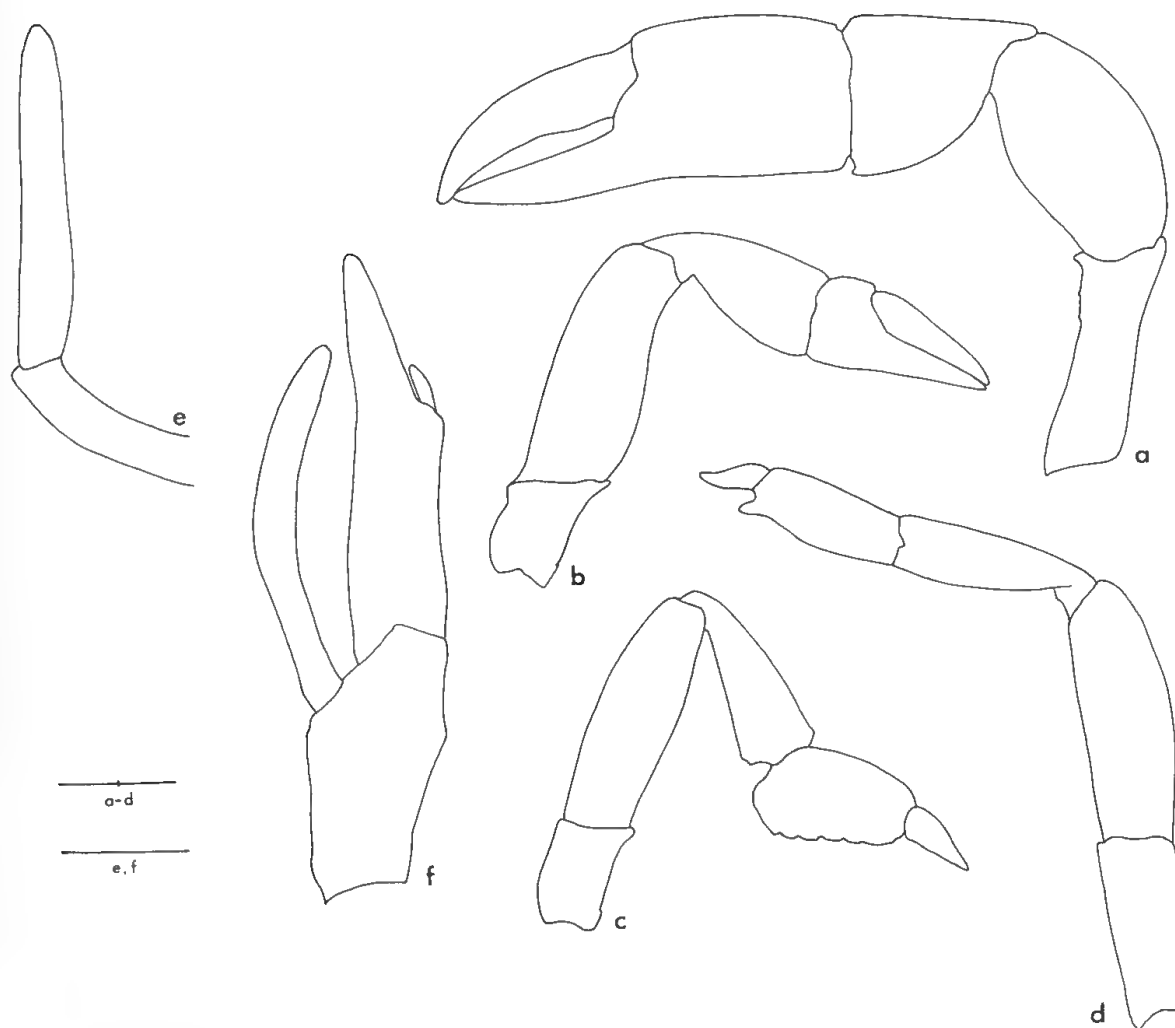


Fig. 35. *Callianassa mucronata* (AM P.2010, male, 33 mm): a, small cheliped; b-d, pereopods 2-4. (AM P.5194, female, 40 mm): e, f, pleopods 1, 2.

***Callianassa tooradin* n. sp.**

Fig. 36

MATERIAL EXAMINED: 2 males, 2 females; tl. 7-24 mm.

HOLOTYPE: NMV. J. 301, female, 19 mm.

TYPE LOCALITY: Victoria: Crib Point, Western Port, CPBS stn 11N, fine sand sediment, 5 m, 31st March, 1965.

PARATYPES: Victoria: Crib Point, Western Port, CPBS stn 11N (NMV J. 302) 2 specs.; CPBS stn 00 (NMV J.303) 1 spec.

DESCRIPTION: Dorsal oval 0.7 length of carapace, clearly delimited. Rostrum a very broad triangular projection about 0.2 length of eyestalks; lateral projections obsolete. Eyestalks extending to end of first article of antenna 1, tapering distally; pigmented area small, compact. Peduncle of antenna 1 reaching to end of article 4 of antenna 2. Antenna 2

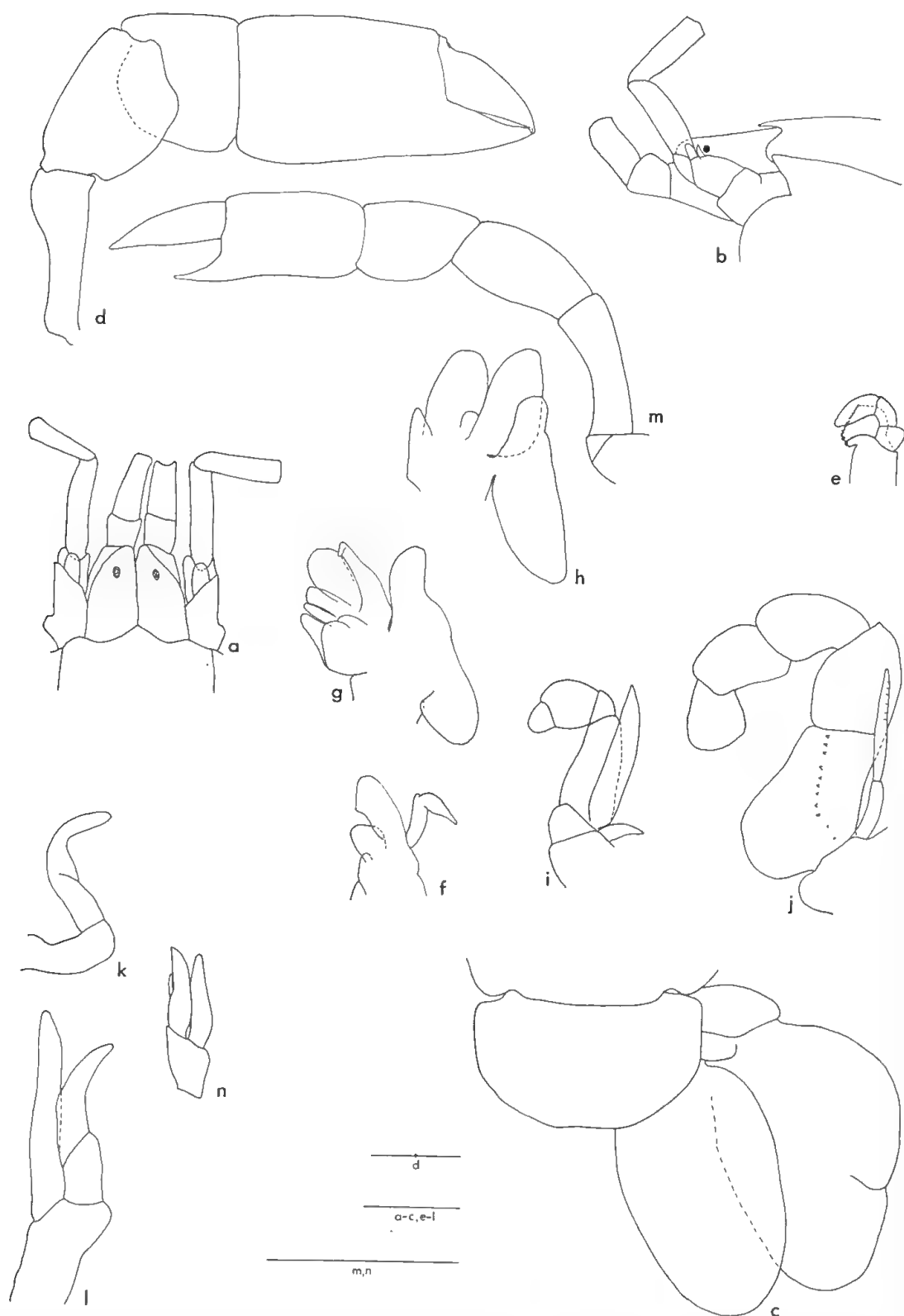


Fig. 36. *Callianassa tooradin* (NMV J.301, female, 19 mm): a, b, dorsal and lateral views of anterior region; c, telson and uropod; d, cheliped; e, mandible; f, g, maxillae, 1, 2; h-j maxillipeds 1-3; k, l, pleopods 1, 2. (NMV J.302, male, 7 mm): m, small cheliped; n, pleopod 2.

with a small scaphocerite, ovate distally. Maxilliped 3 with exopod reaching more than half way along merus; ischium with a proximal medial lobe and with about 11 small spines on inner surface; merus narrower than greatest width of ischium, shorter than ischium; carpus articulating distomedially on merus, curved, broadened distally; propod tapering; dactyl subovate, widest distally, as wide as propod, and reaching back as far as midpoint of ischium. Large cheliped (female) ischium unarmed, dorsally concave; merus strongly lobed ventrally, the lobe unarmed; carpus wider than long, smooth; propod slightly tapering; fixed finger short, tapered; dactyl equal to fixed finger, cutting edge smooth. Large cheliped (male) unknown. Small cheliped unarmed, dactyl twice length of fixed finger. Pleopod 1 (female) 2-articulate. Pleopod 2 (female) biramous, endopod 2-articulate. Pleopod 1 (male) absent. Pleopod 2 (male) biramous, endopod with a medially articulated article. Telson half as long as wide, widest proximally, lateral and posterior margins continuously convex; 2 dorsal tufts of setae and 2 on posterior margin. Uropod endopod ovate, about three times as long as telson; exopod little shorter than endopod, broadly ovate, longer than wide.

DISTRIBUTION: Subtidal (5 m) on fine sand sediments; Victoria (Western Port).

REMARKS: *Callianassa tooradin* is the only species of this genus known from Australia with a substantial exopod on maxilliped 3. This feature is known in only three other *Callianassa* species: *C. novaebritanniae* Borradaile (see De Man (1928a, b) and Sakai (1966)); sometimes in *C. latispina* Dawson (see Biffar (1971a)); and as a very small appendage in *C. karumba*, species which are otherwise little related to each other or to *C. tooradin*. A second feature peculiar to *C. tooradin* is the moderately well developed scaphocerite on antenna 2, an article usually vestigial in species of *Callianassa*. *Callianassa tooradin* is similar in some features to *C. lobata* de Gaillande & Lagardere, 1966, type species of de Saint Laurent's (1973) new genus *Calliax*, notably in the unequal fingers of the smaller cheliped. Species of *Calliax* may possess a third maxillipedal exopod such as occurs in *C. tooradin* but *C. tooradin* cannot easily be placed in this genus because the dorsal oval is well delimited and the chelipeds are unequal. Clearly, more study of relationships within the callianassids is needed before a workable generic subdivision of the many species can be put forward. Our material of *C. tooradin* was a small collection of poorly preserved specimens but their unique position in the Australian fauna made them worth describing at this stage.

***Ctenocheles* Kishinouye, 1926**

DIAGNOSIS: Dorsal oval of the carapace not well delimited, with a median carina on the rostrum and a dorsal projection in the cardiac region. Maxilliped 1 epipod with a short anterior lobe. Maxilliped 3 with or without an exopod, according to species; endopod pediform. Uropod exopod without an anterodorsal lobe, but with a distal indentation. Fingers of the large cheliped very elongate and bearing a comb of fine teeth. (Translated from de Saint Laurent, 1973).

***Ctenocheles collini* Ward**

Fig. 37

Ctenocheles collini Ward, 1945: 134-135, pl.13 (type locality: Queensland, Moreton Bay).
— Holthuis, 1967:377-378.

MATERIAL EXAMINED: 7 specs.

Queensland: Mud Is., Moreton Bay (QM W.3536, paratypes) 3 specs; (QM W.5951-3) 3 specs; (QM W.3184) chela. — no locality (QM W.1670) 1 spec.

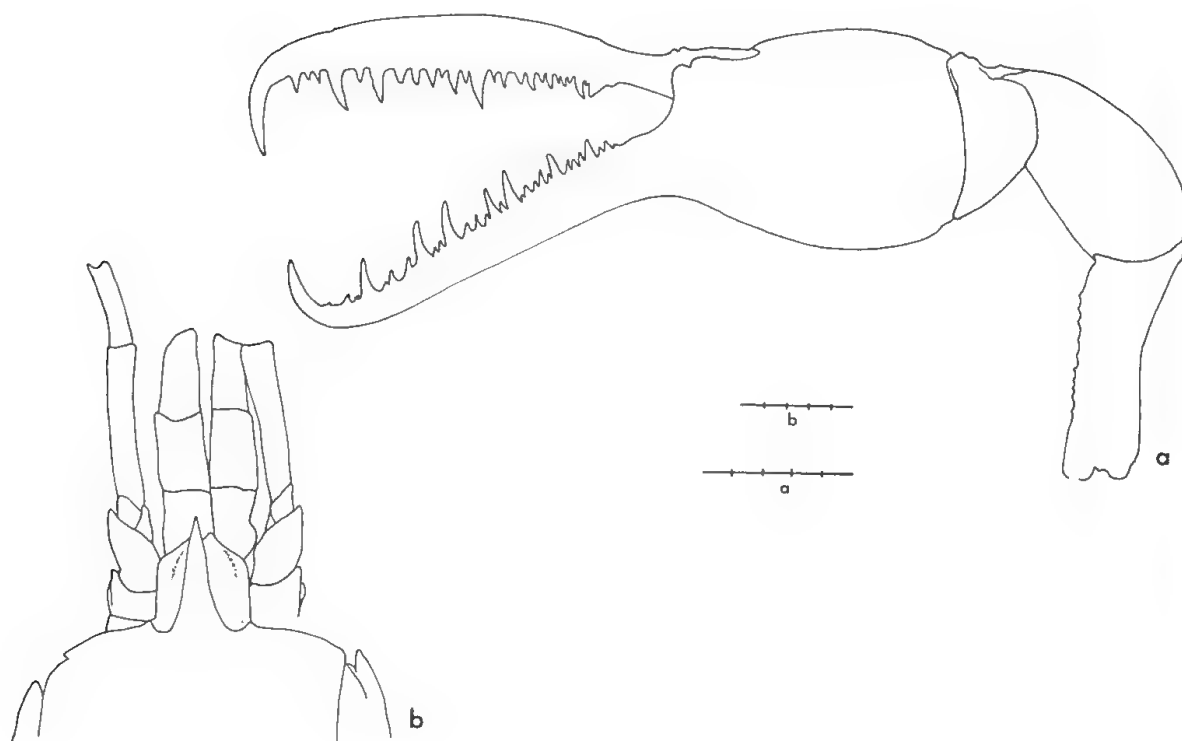


Fig. 37. *Ctenocheles collini* (QM W.1670): a, cheliped; b, dorsal view of anterior region.

DISTRIBUTION: 15-40 m; southern Queensland.

REMARKS: *Ctenocheles* is represented in Australia by a single species, *C. collini*, easily distinguished from all other thalassinideans by the form of the large cheliped. We have not examined a wide range of material of this species and therefore offer no new description.

Gouretia de Saint Laurent, 1973

DIAGNOSIS: Dorsal oval of the carapace not well delimited, with a fine median carina on the rostrum and a slight cardiac protuberance. Maxilliped 1 epipod with a well developed posterior lobe and the anterior lobe truncate towards the front. Maxilliped 3 always with an exopod, endopod pediform. Uropod exopod not lobed, sometimes with a distal indentation. Small cheliped elongate, tapered. (Translated from de Saint Laurent, 1973).

REMARKS: *Gouretia* is possibly the most distinct of de Saint Laurent's (1973) new genera of the Callianassidae and we use it rather than *Callianassa* for the following new species.

Gouretia coolibah n. sp.

Figs 38, 39

MATERIAL EXAMINED: 1 specimen.

HOLOTYPE: WAM 66-75, female, tl. 43mm.

TYPE LOCALITY: *Western Australia*: ca, 215 mi (350 km) ENE. of Troughton Is., Joseph Bonaparte Gulf, 32 fm (58 m), mud, coll. R. W. George on "Dorothea", 23 October 1962.

DESCRIPTION: Dorsal oval 0.7 length of dorsal carapace. Rostrum downturned, an acute triangle as long as broad, half length of eyestalks; lateral projections broad lobes. Eyestalks not reaching to end of first article of peduncle of antenna 1, tapering to a broad mesiodistal lobe; few minute pigment spots subdistally. Peduncle of antenna 1 reaching beyond that of antenna 2; neither antenna very setose. Maxilliped 3 with exopod reaching to end of ischium; merus width 0.2 length of ischium and merus together, merus 0.6 length of ischium; ischium with prominent ridge of 14 teeth on inner surface; carpus articulating

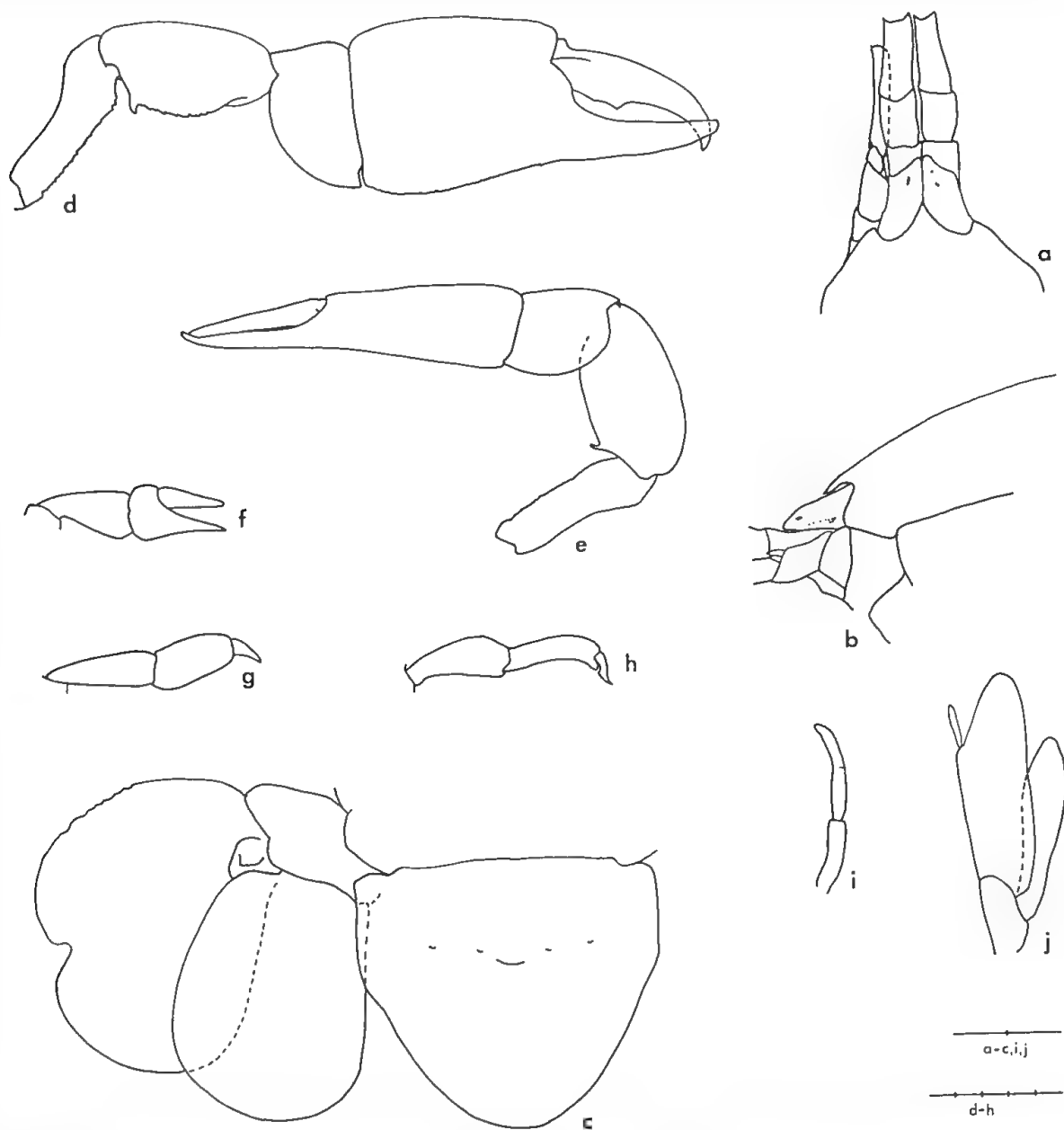


Fig. 38. *Gourretia coolibah* (WAM 66-75, female, 48 mm): a, b, dorsal and lateral views of anterior region; c, telson and uropod; d, large cheliped; e, small cheliped; f, g, h, pereopods 2, 4, 5; i, j, pleopods 1, 2.



Fig. 39. *Gourretia coolibah* (WAM 66-75, female, 48 mm): a, mandible; b, c, maxillae 1, 2; d-f, maxillipeds 1-3.

terminally on merus, longer than merus, subtriangular; propod subovate, convex medially and tapering; dactyl 0.7 times length of propod, narrower. Large cheliped (female) ischium dentate ventrally; merus with dentate, convex ventral margin with a curved proximal tooth; carpus twice as wide as long; propod smooth dorsally, crenulate ventrally; fixed finger smooth and evenly tapering to blunt tip; dactyl equal to fixed finger, strongly curved, a blunt double tooth on cutting edge; ratio of dorsal lengths — merus: carpus: propod — 1:0.5:1.2. Large cheliped (male) unknown. Small cheliped ischium minutely dentate; merus with ventral spine proximally; carpus longer than wide; propod uniformly tapering; fixed finger and dactyl equal, curved terminally, cutting edges irregular. Pleopod 1 (female) uniramous, 2-articulate, second article with lobe midway along. Pleopod 2 (female) biramous, exopod broad, shorter than 2-articulate endopod, second article of endopod small and articulating on medial edge of first. Pleopods (male) unknown. Telson little wider than long, proximal half parallel-sided then tapering to broadly rounded end,

setose terminal margin and scattered setae dorsally. Uropod endopod longer than wide, subequal to telson, lateral and distal margins convex, continuous; exopod strongly convex laterally, distal margin notched and strongly convex medially of notch, setose marginally.

DISTRIBUTION: Deep mud; north Western Australia.

REMARKS: This is the first record of this genus from Australia. The species is distinguished superficially from all other Australian callianassids by the narrow, tapering small cheliped and the notched uropod exopod.

G. coolibah is distinguished from other species of this genus (see Le Loeuff & Intes, 1974) by the poor dentition of the chelipeds among other features and by the notch on the distal margin of the uropod exopod. It most closely resembles *G. lahouensis* Le Loeuff & Intes, 1974.

Family **Callianideidae** De Man, 1928

Callianidea Milne-Edwards, 1837

DIAGNOSIS: Carapace smooth, cervical groove poorly marked, rostrum short, not carinate. Eystalks contiguous, cornea subdistal. Maxilliped 3 with an exopod, endopod pediform, epipod short. Pereopods 1 unequal or equal, carpus much wider than merus. Pleopods 2-5 bordered by branchial filaments.

REMARKS: This diagnosis is translated from de Saint Laurent (1973) with the exception of the remark on the inequality of the first pereopods. The following new species has equal pereopods 1 and the diagnosis has been expanded to include it. Stephenson et al. (1931) noted a species of *Callianidea* from sandy areas on Low Isles, north Queensland. Dr Ray Ingle tried to locate this specimen for us, but it is not in the thalassinid material at the BM(NH) with the other specimens from this expedition, so we are unable to confirm the record.

Callianidea leura n. sp.

Figs 40, 41

MATERIAL EXAMINED: 2 females; tl. 25 mm.

HOLOTYPE: AM P.25294, ovigerous female, tl. 25 mm.

TYPE LOCALITY: *Queensland*: Masthead Is., Capricorn Group.

PARATYPE: *Queensland*: Holbourne Is. (AM P.5574) 1 spec.

DESCRIPTION: Cervical groove indistinct. Rostrum flat, slightly depressed distally, as long as broad, end bluntly rounded, 0.4 length of eyestalks; front deeply excavate at base of eyestalks, with a short longitudinal row of setae behind; dorsolateral anterior margin of carapace broadly rounded. Eyestalks reaching to midpoint of second article of antenna 2, somewhat flattened, broadly rounded terminally; eyes subdistal. Peduncles of antenna 1 and 2 of about equal length. Article 1 of antenna 1 extremely elongate, more than 3 times as long as last 2 articles together, strongly tapering to its midpoint and dilating slightly distally. Antenna 2 with an acute scaphocerite, article 4 about 3 times as long as article 2. Maxilliped 3 with exopod reaching almost to end of merus; merus width 0.2 length of ischium and merus together, merus longer than ischium; ischium with a mesial row of about 10 small denticles; merus with a strong medial spine subdistally; carpus, propod and dactyl all about as wide as end of merus, together longer than previous two articles. Chelipeds

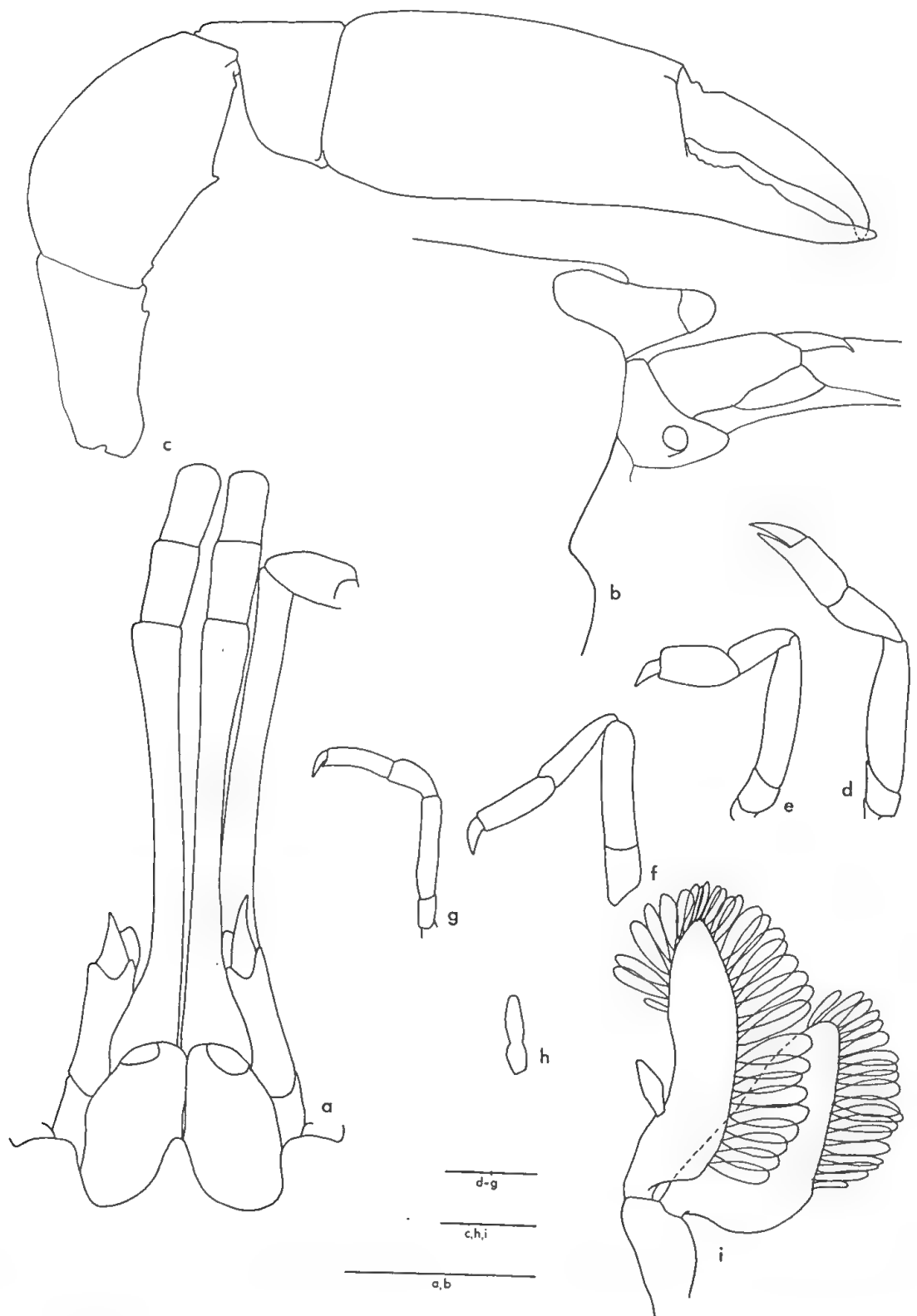


Fig. 40. *Callianidea leura* (AM P.25294, female, 25 mm): a, b, dorsal and lateral views of anterior region; c, cheliped; d-g, pereopods 2-5; h, i, pleopods 1, 2.

equal; ischium with a small medial tooth; merus strongly convex dorsally, its ventral margin with a small tooth near midpoint; margins of carpus and propod smooth; fixed finger tapering, cutting edge with 2 low teeth proximally; dactyl equal to fixed finger, sinuate cutting edge, curved end; ratio of dorsal lengths — merus: carpus: propod — 1:0.6:1.3. Pleopod 1 (female) a single small article, constricted near the midpoint. Pleopod 1 (male) unknown. Pleopods 2-5 similar, both rami bearing simple narrowly-ovate branchial filaments. Telson length 0.8 width, proximal half parallel-sided then tapering to broadly rounded end. Uropod endopod 1.5 times as long as telson, ovate, length 1.2 times width, bearing a minute terminal tooth; exopod about as long as endopod, broadly ovate, length 1.5 times width.

DISTRIBUTION: Central Queensland.

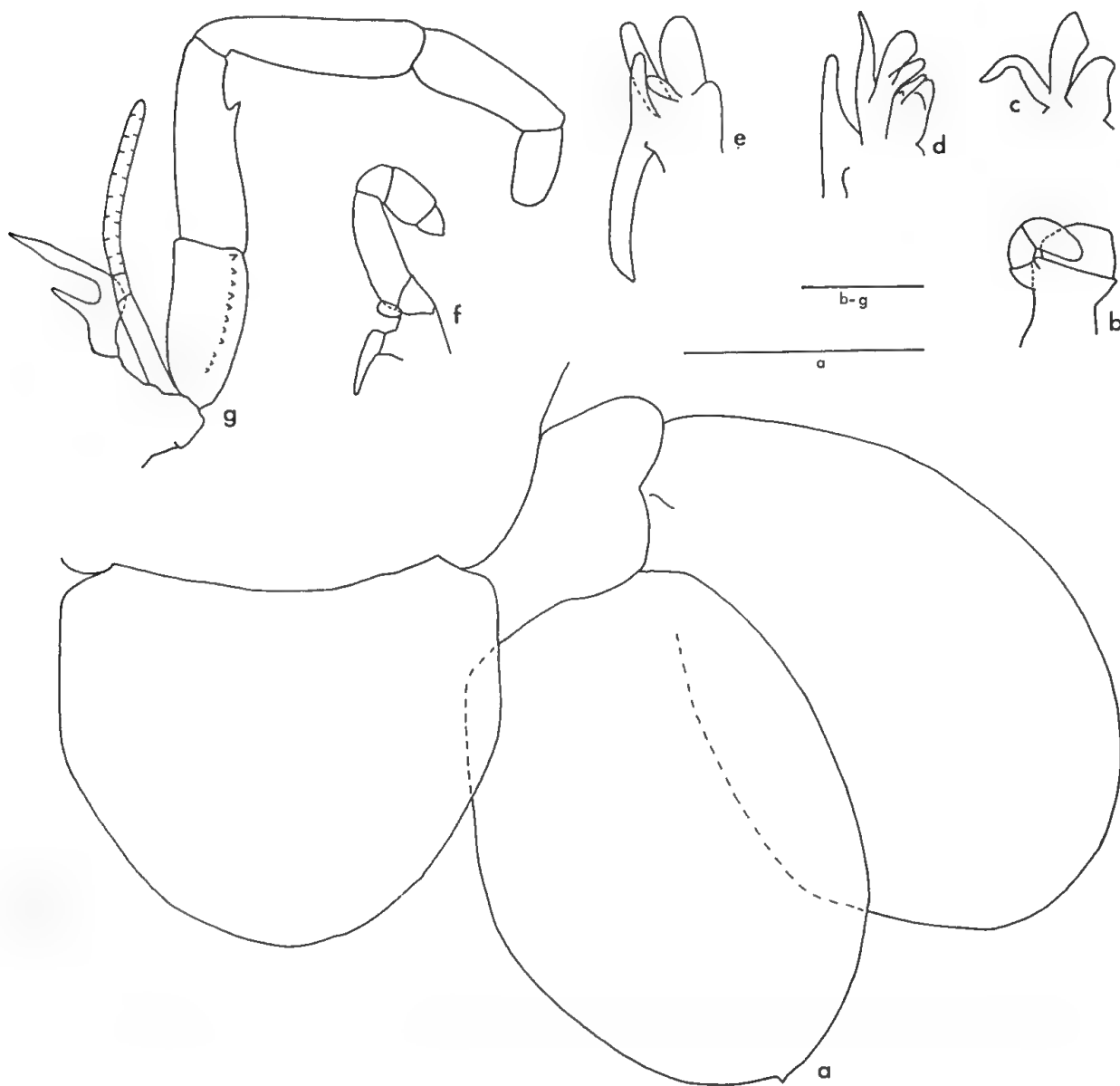


Fig. 41. *Callianidea leura* (AM P.25294, female, 25 mm): a, telson and uropod; b, mandible; c, d, maxillae 1, 2; e-g, maxillipeds 1-3.

REMARKS: This species is similar in general form to species of *Callianassa* but in Australia is distinguished from these by the branchial filaments on pleopods 2-5. *Callianidea leura* differs from other species of *Callianidea* in a number of important features which might be considered of generic status. The pleopodal branchial filaments which characterize the genus are simple in *C. leura* but branched or multiarticulate in other species (De Man, 1928a), pereopods 1 are equal in *C. leura*, unequal in others, and article 1 of antenna 1 is extremely elongate in this species but of a more normal length (about equal to the eyestalks) in others.

Family **Laomediidae** Borradaile, 1903

Laomedia De Haan, 1841

DIAGNOSIS: Pereopods 1 subequal; pereopods 2 subchelate or simple; uropods with transverse suture on both endopod and exopod; pleopod 1 (male) absent; pleopod 1 (female) reduced and uniramous; pleopods 2-5 similar, bearing appendix interna.

REMARKS: Yaldwyn & Wear (1972) have given a more complete diagnosis and Le Loeuff & Intes (1974) discussed the relationships of the genus *Laomedia*.

Laomedia healyi Yaldwyn & Wear

Laomedia healyi Yaldwyn & Wear, 1970:384-385, fig. 1 (type locality: New South Wales, Careel Bay); 1972: 126-141 figs 1-12, pls 6-7. — Healy & Yaldwyn, 1970: frontispiece.

MATERIAL EXAMINED: 10 specimens; cl. 18-26 mm.

Queensland: Hayman Is., Whitsunday Group (AM P.7306) 1 spec. — Russell Is., Moreton Bay (QM W.1974) 1 spec. — Southport (QM W.4538) 1 spec.

New South Wales: Woy Woy (AM P.4027) 1 spec. — Port Jackson (AM P.4673) 1 spec. — Figtree, Lane Cove (AM P.7079) 1 spec. — Back Creek, Tuross Lake (AM P.25016) 1 spec.

Victoria: Hastings, Western Port (NMV, Ahsanullah colln) 3 specs.

DISTRIBUTION: Intertidal, often in mangroves; northern Queensland to central Victoria.

REMARKS: This species has been described and illustrated in detail previously (Yaldwyn & Wear, 1970, 1972) and is therefore not dealt with here. It is most easily distinguished from other thalassinideans by both rami of the uropod being 2-articulate. The range of the species is extended here down to central Victoria by the discovery of material from intertidal mangroves in Western Port.

Laomedia sp.

Laomedia n. sp. (Barron River) Yaldwyn & Wear, 1972: 126, 129-31.

REMARKS: This, as yet undescribed, species is known only from the Queensland material noted by Yaldwyn & Wear (1972). It is separated from *L. healyi* by a number of features, the most notable being the presence of only one small tooth beside the terminal rostral tooth (rather than 3-6) and the absence of orbital and antennal spines on the anterior margin of the carapace (Yaldwyn & Wear, 1972).

Family **Thalassinidae** Dana

The family is monogeneric.

Thalassina Latreille, 1806

DIAGNOSIS: Thalassinidea with linea thalassinica present; rostrum small and triangular; pereopods 1 unequal, subchelate, dactyl greatly exceeding fixed finger; pereopods 2 subchelate; pleopods lacking appendix interna; uropod rami each of a single, linear curved article.

Thalassina squamifera De Man

Fig. 42

Thalassina anomala var. *squamifera* De Man, 1915: 445, pl.29 fig. 16 (type locality: Karakelong, Indonesia); 1928a: 12-14, pl. 1 fig. 1.

Thalassina anomala. — De Man, 1928a: 4-12 (part). — Bennett, 1968: 22-25, figs (part). — Stephenson et al., 1931: 40-42. — McNeill, 1968: 26.

Thalassina maxima Hess, 1865: 163, pl.7 fig.18. — Haswell, 1882: 166-167.

Thalassina sp. — Haswell, 1882: 167.

Thalassina squamifera. — Campbell & Woods, 1970: 41-42.

MATERIAL EXAMINED: 7 males, 4 females, 21 others; cl. 35-60 mm.

Queensland: Weipa (WAM 186-62) 1 spec. — Silver Plains Station, Cape York (AM P.16154) 1 spec. — Palm Is. (AM P.5210,1) 2 specs. — Port Curtis (AM P.16155) 2 specs; (AM P. 17423) 1 spec.; (AM P.16780) 5 specs. — Gladstone (AM P.14978,9) 2 specs.

Northern Territory: Darwin (AM P.12519) 1 spec.; (AM P.14980) 1 spec.; (WAM 42-75) 1 spec. — Cape Don (WAM 39-75) 1 spec. — Napier Bay, Melville Is. (AM P.18776) 1 spec.

Western Australia: North coast of W.A. (WAM 187-62) 1 spec. — Wyndham (WAM 43-75) 1 spec. — Broome (AM P.15055) 1 spec.; (WAM 168-60) 1 spec. — 27 km SE. of Broome (WAM 38-75) 1 spec. — Port Hedland (WAM 9302) 1 spec.; (WAM 37-75) 1 spec.; (WAM 44-75) 1 spec.; (WAM 169-60) 1 spec. — Roeburne (WAM 188-62) 1 spec. — Learmonth (WAM 181-60) 1 spec. — north of Perth (AM P.14982) 1 spec.

Philippines: Laguio Point, Lopez Bay (WAM 45-75) 1 spec.

DISTRIBUTION: Intertidal mangrove mudflats and down to 13 m; Philippines; Irian Jaya and Karakelong, Indonesia (De Man 1928a); north Western Australia, Northern Territory and north Queensland.

REMARKS: *Thalassina squamifera* was first described from specimens from Indonesia as a variety of the widespread species *T. anomala*. Campbell & Woods (1970) first elevated the variety to specific rank after an examination of Australian material and our material confirms their determination. The ranges of the two species overlap in Indonesia and the Philippines.

Thalassina anomala and *T. squamifera* are very close species, differing in three characters already noted by De Man (1928a).

1. In *T. squamifera* the transverse sternal ridge between the pleopods on pleonites 2-5 is medially emarginate and laterally tuberculate; in *T. anomala* this ridge bears a single prominent tubercle medially.

2. *T. squamifera* bears a small, variously sized, scaphocerite; *T. anomala* lacks this feature although Sankolli (1970) noted its presence on two out of 70 specimens from India.

3. *T. squamifera* lacks the oblique tuberculate ridge which runs on the lateral surface

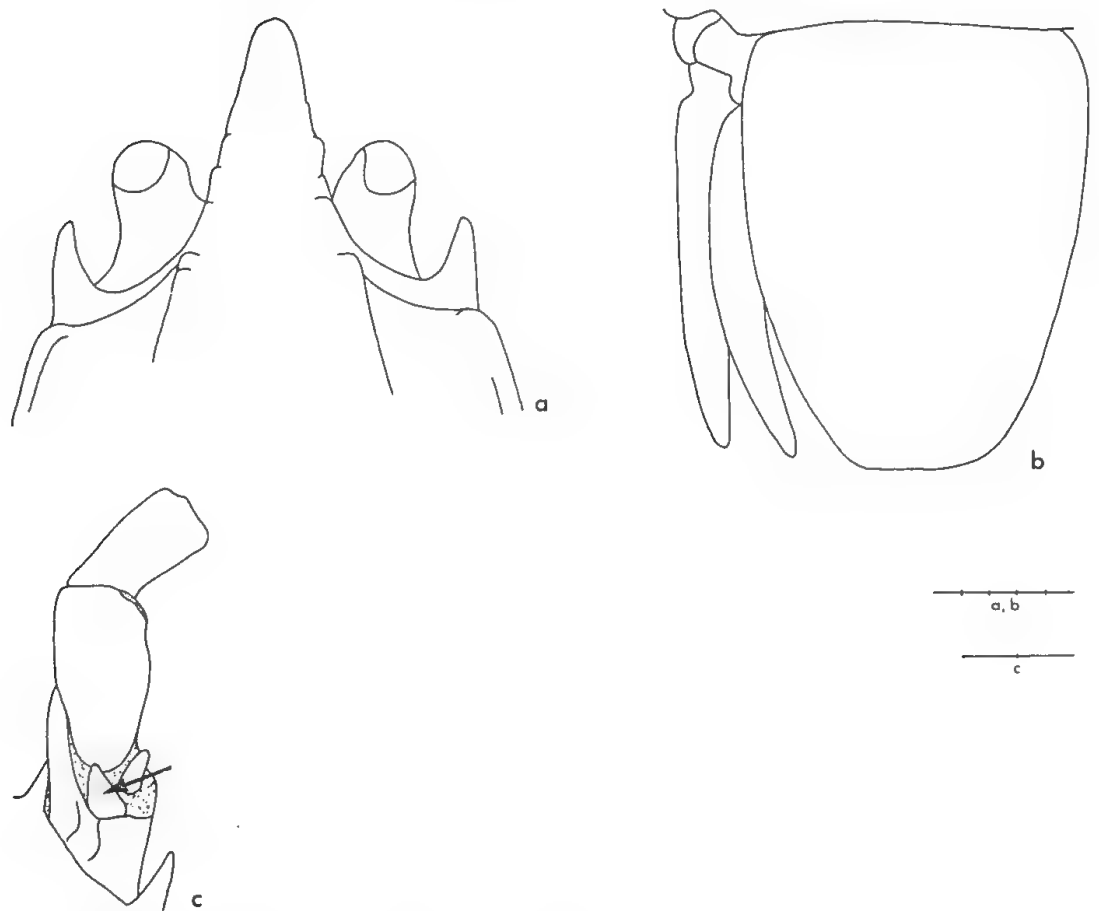


Fig. 42. *Thalassina squamifera* (WAM 186-62, female, 54 mm): a, rostrum; b, telson and uropod; c, right antenna 2 and anterior margin of carapace (dorsal view, scaphocerite arrowed).

parallel to the proximal cutting edge of the fixed finger of the large cheliped in *T. anomala*. Sankolli (1970) noted that Indian specimens of *T. anomala* also lacked this ridge but in his material the chelipeds differed little in size but not at all in form. Our examination of material of *T. anomala* in the Australian Museum from Samoa, the Solomon Is., New Guinea, Fiji and the New Hebrides confirmed De Man's (1928a) observation that the tuberculate ridge occurs on the larger cheliped only when its propod is strongly expanded distally. In spite of some of Sankolli's material being sexually mature this condition was not met. We also note from our examination of Australian material that *T. squamifera* is a smaller species than *T. anomala*, its maximum carapace length being 60 mm, compared with about 100 mm for *T. anomala*.

The species *Thalassina maxima* was described by Hess (1865) from Sydney (Haswell, 1882; De Man, 1928a). Considering the present-day distribution of Australian *Thalassina* this is a most unlikely locality record. Observations on the burrowing behaviour of *Thalassina* in northern Queensland mangrove forests were made by Macnae (1966).

Family Upogebiidae Borradaile, 1903

Upogebia Leach, 1814

DIAGNOSIS: Carapace with a well-developed rostrum, spinous; cervical groove

separating essentially equal anterior and posterior regions. Linea thalassinica present. Pleurobranchs absent; pereopod epipods absent. Eyestalks cylindrical with terminal eyes. Scaphocerite reduced. Maxilliped 1 exopod slender, with a terminal flagellum; endopod short and epipod rudimentary or absent. Maxilliped 3 with an exopod; endopod pediform, usually without *crista dentata* (mesial crest of teeth on ischium); epipod vestigial or absent. Pereopods 1 equal, chelate, subchelate or simple. Pereopods 2, 3, 4 simple. Pereopod 5 subchelate or chelate. Pleopod 1 present in female only. Pleopods 2-5 similar, foliaceous, without appendix interna. Uropod exopod not lobed. (Modified from a translation of the family diagnosis given by de Saint Laurent (1973)). The family is monogeneric.

***Upogebia (Calliadne) australiensis* De Man**

Fig. 43

Gebia hirtifrons. — Haswell, 1882: 164-165 (type locality: Port Jackson, N.S.W.). (Not *Gebia hirtifrons* White, 1847.)

Upogebia octoceras australiensis De Man, 1927: 14-17; pl. 2 fig. 7; 1928a: 24, 49.

Upogebia (Calliadne) australiensis. — Hale, 1941: 273-274, fig. 9.

MATERIAL EXAMINED: 53 specs; cl. 4-15 mm.

Queensland: Port Molle (AM P.260) 1 spec.

New South Wales: Broughton Is. (AM P.263) 1 spec. — Avalon (AM P.24679) 1 spec. — Collaroy (AM P.13505) 1 spec. — Balmoral Beach (AM P.1696) 7 specs. — Port Jackson (AM P.262 syntypes) 3 specs; (AM P.24701) 9 specs; (AM P. 25529) 1 spec.; (AM P.5184) 5 specs.; (AM P.6747) 1 spec.; (AM P.6760) 2 specs. — Dobroyd Pt, Sydney (AM P. 20835) 1 spec. — Syney area (AM P. 16206) 2 specs. — Bondi Beach (AM P.5653) 1 spec.; (AM P.5652) 2 specs.

Western Australia: Bunbury (AM P.2454) 15 specs.

DESCRIPTION: Rostrum weakly trilobed, lateral lobes 0.1 length of medial lobe, hiatus between lobes a shallow broad U, total length about equal to width at base; surface of medial lobe tuberculate, without spines, its lateral edge with about 6 blunt tubercles, lateral lobes with up to 15 close-set blunt tubercles along lateral edges extending back to cervical groove; setae on dorsal surface of medial lobe of rostrum and along lateral edges of lateral lobes; without ventral teeth. No spine on anterolateral border of carapace, nor on lateral border of cervical groove. Eyestalk about 0.8 length of rostrum. Maxilliped 3 exopod exceeding merus; ischium without hook; ischium and merus together about as long as last 3 articles; dactyl 1.5 times length of propod. Pereopods 1 equal, not sexually dimorphic; coxa unarmed, double ventral setal row on ischium and merus, single dense row on proximal half of propod; merus smooth; distal margin of carpus with dorsal denticles, a mesial and a ventral spine, dorsal patch of dense setae subdistally; fixed finger of propod almost as long as dactyl, cutting edge strongly toothed, a small slender spine on both lateral and mesial surface of propod distally at junction with dactyl; dactyl with a proximal tooth on cutting edge, a short longitudinal row of tubercles on mesial surface; ratio of dorsal lengths — merus: carpus: propod — 1:0.3:1. Pereopods 2-5 unarmed. Pleopod 1 (female) 2-articulate, second article longer. Pleopod 1 (male) absent (or if present of form of female). Telson quadrate, length equal to width, a strong transverse ridge close to base and longitudinal ridge near each lateral edge, ridges and area immediately behind transverse ridge with small spines, those on lateral ridges generally in pairs. Posterior edge of sixth abdominal segment with small spines. Uropod endopod no longer than telson, lateral edge straight, distal margin very weakly convex, with single longitudinal ridge; exopod longer than endopod, distal edge evenly curved, surface with double ridge, minute denticles on distal edges of both exopod and endopod.

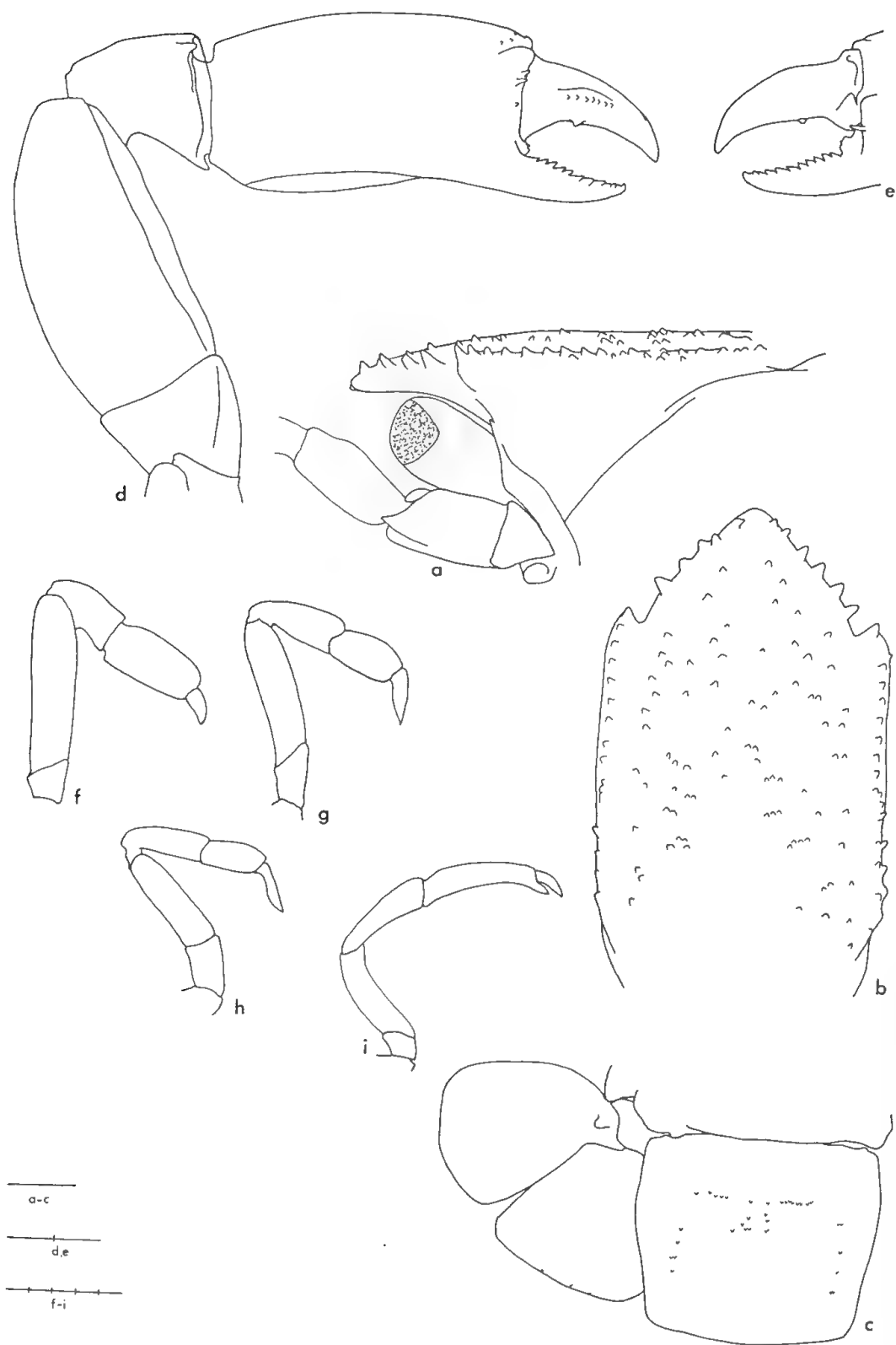


Fig. 43. *Upogebia australiensis* (AM P.25529, female, 14 mm): a, b, dorsal and lateral views of anterior region; c, telson and uropod; d, pereopod 1 (medial view); e, chela (lateral view); f-i, pereopods 2-5.

DISTRIBUTION: Often recorded from within sponges, from intertidal down to 62 m (Hale, 1941); northern Queensland to central N.S.W., and Western Australia. Not yet recorded from Victoria or South Australian waters.

REMARKS: This species was first described as a variety of the Red Sea species *U. octoceras* Nobili. Hale was the first to elevate it to full specific status. It has been adequately dealt with by De Man and by Hale. Our specimens agree in all major respects. However, our specimens possess on the distal edge of the propod of pereopod 1, a single mesial spine and a small spinule plus a single lateral spine and spinule. Hale figured the propod with 2 spines mesially and 2 laterally. The species is superficially similar to *U. hexaceras* from which it differs in the broader and more tuberculate rostrum. The lateral lobes of the rostrum are short in both species.

***Upogebia (Calliadne) bowerbankii* (Miers)**

Figs 44, 45

Gebiopsis bowerbankii Miers, 1884: 282 (type locality: Fremantle, W.A.).

Upogebia bowerbankii. — Hale, 1924: 69; 1927: 85; 1941: 274-276, fig. 10. — De Man, 1927: 9-12, pl. 1 fig. 4; 1928a: 24, 48.

Upogebia (Calliadne) bowerbankii. — Sakai, 1975: 13-17, fig. 3.

MATERIAL EXAMINED: 25 males, 23 females; cl. 4-17 mm.

South Australia: Decres Bay (WAM 63-75) 5 specs. — Backstairs Passage (SAM C.891) 2 specs. — Spencer Gulf (AM P.24671) 2 specs.

Western Australia: Lancelin Is. (WAM 54-75) 6 specs. — Cottesloe (WAM 374-377-31) 4 specs; (WAM 3-75) 1 spec; (WAM 10767) 1 spec; (WAM 10365-10373) 8 specs; (WAM 10148) 2 specs. — near Perth (WAM 56-75) 1 spec. — 8.8 km NE. of Rottnest Is. (WAM 72-65) 1 spec. — Fremantle (BM (NH) 61-97 holotype) 1 spec. — 1 km W. of Garden Is. (WAM 68-72) 6 specs; (WAM 60-75) 1 spec; (WAM 66-72) 2 specs. — Esperance (WAM 122-75) 2 specs. — Green Is., Oyster Harbour (WAM 52-75) 2 specs. — 96-128 km W. of Eucla (AM P.25288) 1 spec.

DESCRIPTION: Rostrum trilobed, lateral lobes about one quarter length of medial lobe; medial lobe evenly rounded and slightly depressed distally, about half as long as wide, with 5-6 strong, dorsally-directed, equal marginal spines on each side; lateral lobe an acute spine ending a row of about 20 shorter spines on dorsolateral margin of carapace. Dorsal surface of carapace, particularly of rostrum, spinose; densely setose only near margin of medial lobe of rostrum; carapace otherwise unarmed. Eyestalk reaching midway between ends of lateral and medial lobes of rostrum. Maxilliped 3 exopod reaching beyond midpoint of merus; ischium with small mesial spine proximally; merus shorter than ischium, together longer than last 3 articles; dactyl as long as propod. Pereopods 1 subequal, double ventral setal row on ischium and merus, single row on proximal half of propod; carpus with a strong mesiodistal spine and 3-4 minute mesial spines; propod with several minute dorsal spines distally, 2 mesial, 1 dorsal and 1 lateral spines on distal margin of propod at base of dactyl; fixed finger regularly (rarely irregularly) toothed on cutting edge; dactyl and fixed finger subequal, dactyl with a proximal dorsal tubercle, a mesial row of denticles, and a blunt proximal tooth near uneven cutting edge; ratio of dorsal lengths-merus: carpus: propod — 1:0.4:0.8. Pereopods 2-5 unarmed. Pleopod 1 (female) 2 — articulate. Pleopod 1 (male) absent. Telson as long as wide, scarcely tapering, posterior edge concave, sometimes scarcely; with a proximal spinulose transverse ridge, a pair of spinulose domes posterior to this, and longitudinal submarginal ridges; uropod endopod

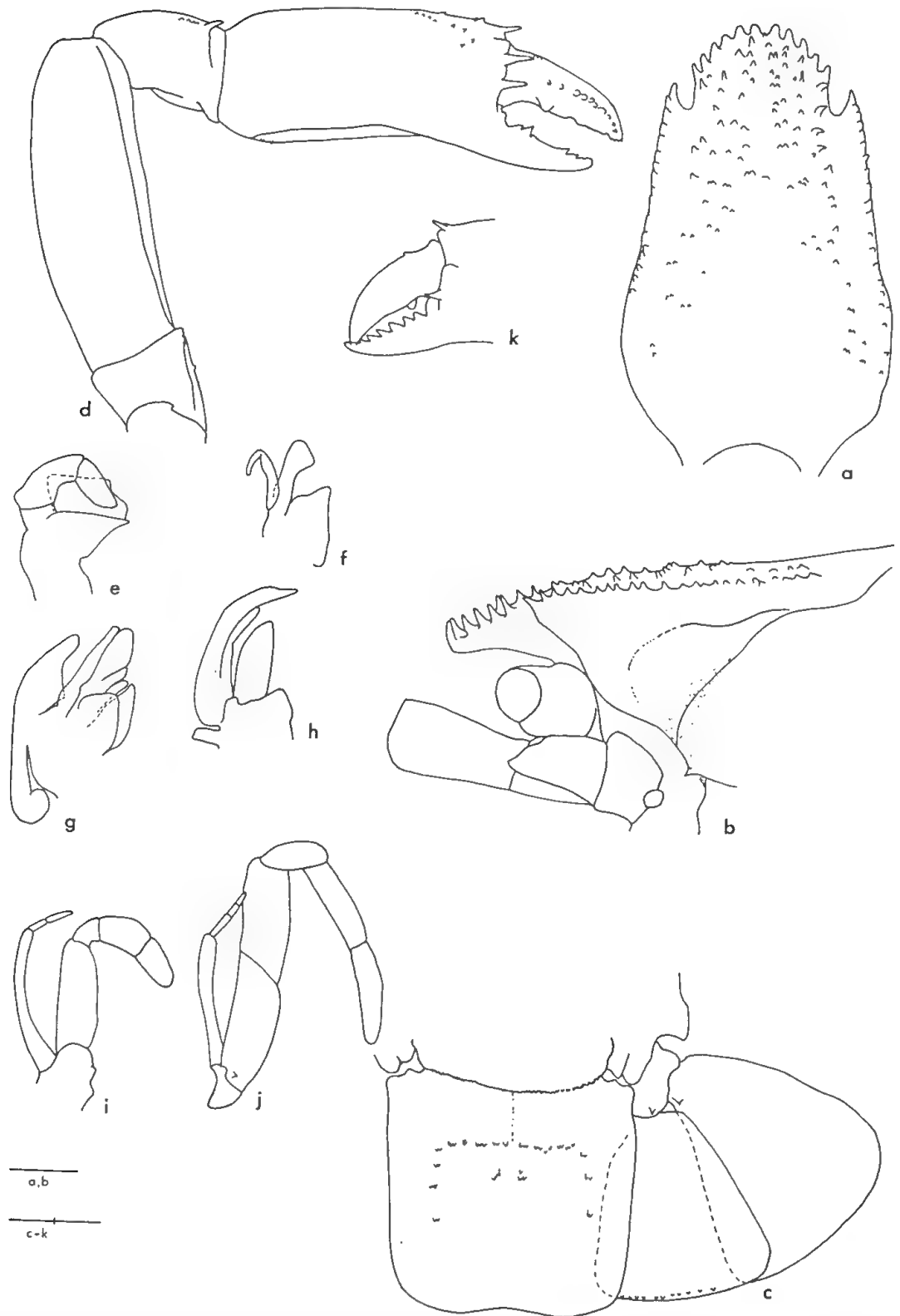


Fig. 44. *Upogebia bowerbankii* (AM P.25288, female, 13 mm): a, b, dorsal and lateral views of anterior region; c, telson and uropod; d, pereopod 1; e, mandible; f, g, maxillae 1, 2; h-j, maxillipeds 1-3. (WAM 54-75, male, 13 mm): k, chela (lateral).

as long as telson, with a longitudinal ridge, distal margin weakly convex and with submarginal denticles; exopod equal to endopod, distal and lateral margins convex.

DISTRIBUTION: Often taken in sponges, 6-200 m; South Australia and southern Western Australia.

REMARKS: The holotype of this species was obtained on loan from the British Museum (Natural History) as De Man's (1927) illustration of it could not be reconciled with Hale's (1941) figure and description, nor with the large series of specimens from the Western Australian Museum. The rostrum of the holotype proved to have been damaged at some stage in the life of the animal resulting in a transverse line of non-calcification at the level of the second most distal pair of spines. The terminal pair of spines are a little more elongate than usual, the second pair quite soft and slender and the whole of the rostrum excessively depressed. Otherwise the specimen cannot be distinguished from the WAM material. The fixed finger of the cheliped illustrated (fig. 44d) is not typical of the species; fig. 44k is more representative.

U. bowerbankii is distinguished from other Australian *Upogebia* by the evenly curved, broad rostrum bearing 5-6 equal spines on each side. Having the fixed finger and dactyl subequal, it belongs in the subgenus *Calliadne*.

Sakai (1975) assigned four specimens from Kenya to this species noting some differences from De Man's (1927) redescription of the type specimen. Our examination of a wider range of Australian material leads us to suspect that the Kenyan material is not *U. bowerbankii*. Sakai's (1975) illustration and description of the medial lobe of the rostrum differ in having fewer marginal spines (7-9 vs 10-12), being longer and more tapered, and in barely exceeding the eyestalks (twice as long in our material). The lateral lobes of the rostrum are more prominent and the fixed finger bears more teeth in Australian specimens. Sakai found the spination of the propod of the first pereopod to be variable; our material was constant although it fell within the range given by Sakai.

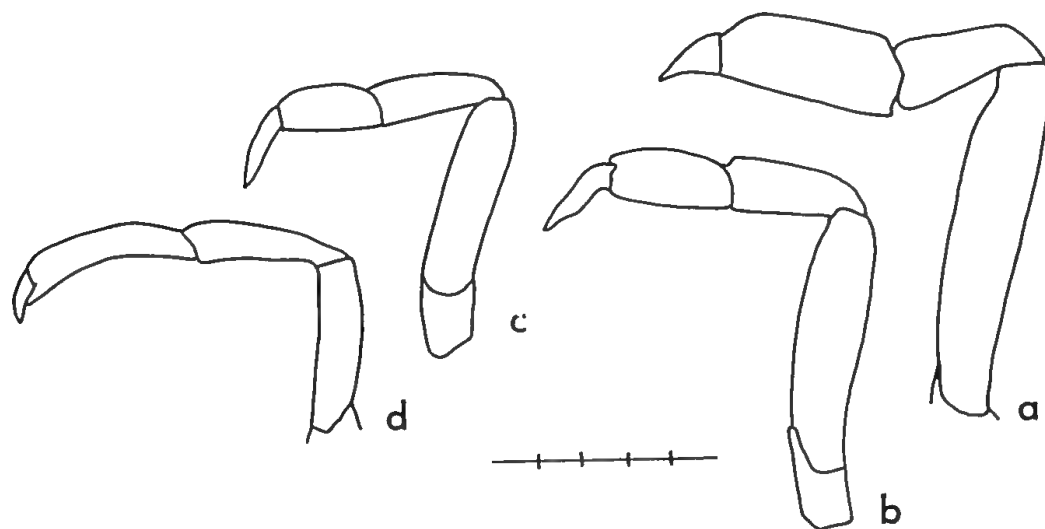


Fig. 45. *Upogebia bowerbankii* (WAM 54-75, male, 13 mm): a-d, pereopods 2-5.

Upogebia (Upogebia) carinicauda (Stimpson)

Gebia carinicauda Stimpson, 1860: 23 (type locality: Hong Kong). — Miers, 1884: 280.

Gebia barbata Strahl, 1861: 1062, figs 7-9.

Upogebia carinicauda. — De Man, 1928a: 22, 44, 60-65, pls 3, 4 figs 6-6n (includes complete synonymy).

DISTRIBUTION: Hong Kong through southeast Asia, Samoa and Solomon Islands and including Thursday Island in Torres Strait. See De Man (1928a) for details of localities.

REMARKS: The specimens recorded by Miers (1884) are from Thursday Island, north of Cape York, Australia, and De Man (1928a) confirmed their identification.

No material of this species exists in Australian museums but De Man's (1928a) description and figures are probably adequate to recognize the species. The fixed finger is shorter than the dactyl (subgenus *Upogebia*); the rostrum short, rounded anteriorly and bearing 4 spiniform teeth; the telson distinctly broader than long and bearing a sharp transverse carina anteriorly which is continuous with the lateral carinae. The absence of spinules on these carinae distinguish *U. carinicauda* from many other Australian species.

Upogebia (Calliadne) darwinii (Miers)

Fig. 46

Gebiopsis darwinii Miers, 1884: 281-282, pl. 32 fig. A (type locality: Darwin, N.T.).

Gebiopsis intermedia D Man, 1888: 256, pl. 16 fig. 2.

Upogebia darwinii. — Hale, 1927: fig. 82. — De Man, 1928a: 24, 50, 84-86, pls 8,9, figs 12-12f (includes complete synonymy).

Upogebia darwini. — Ngoc-Ho, 1977: 439-464, figs. 1-13.

MATERIAL EXAMINED: 5 females, 5 males; cl. 5-8 mm.

Western Australia: Cockatoo Is. (WAM 32-75) 1 spec.

Northern Territory: Fannie Bay, Darwin (AM P.24663) 1 spec.

Queensland: Cape York, Somerset Beach (AM P.24812) 4 specs; (AM P.24808) 1 spec. — Thursday Is. (AM P.24809) 1 spec. — Prince of Wales Is. (AM P.24815) 2 specs.

DESCRIPTION: Rostrum trilobed; medial lobe as long as wide, depressed, with a subterminal and lateral spine on each side; lateral lobes about $\frac{1}{8}$ as long as medial lobe and separated from it by a sharp V, with a subterminal dorsal spine and numerous small spines along the dorsolateral margin of the carapace. Dorsum with few spines laterally in gastric region, densely setose on medial lobe. Minute spine on anterolateral margin of carapace (right side only in (WAM 32-75)); no spines on cervical groove. Eyestalk more than half length of rostrum. Maxilliped 3 exopod longer than ischium; ischium with hook on mesial face; merus about as long as ischium and together about as long as last 3 articles. Pereopods 1 equal; double ventral setal row on ischium and merus; coxa with posterodistal hook; ischium with 1 ventral spine; merus with up to 10 short ventral spines and 1 strong distal dorsal spine; carpus with 1 ventral, 1 dorsal and 1 medial spine on distal margin, propod smooth dorsally and ventrally; fixed finger $\frac{2}{3}$ length of dactyl, cutting edge irregularly serrate; dactyl scarcely curved, cutting edge irregularly serrate; ratio of dorsal lengths — merus: carpus: propod — 1:0.6:1. Pereopod 2 with dorsal spine on merus; pereopods 3-5 unarmed. Pleopod 1 (female) 2-articulate, second article shorter than first.

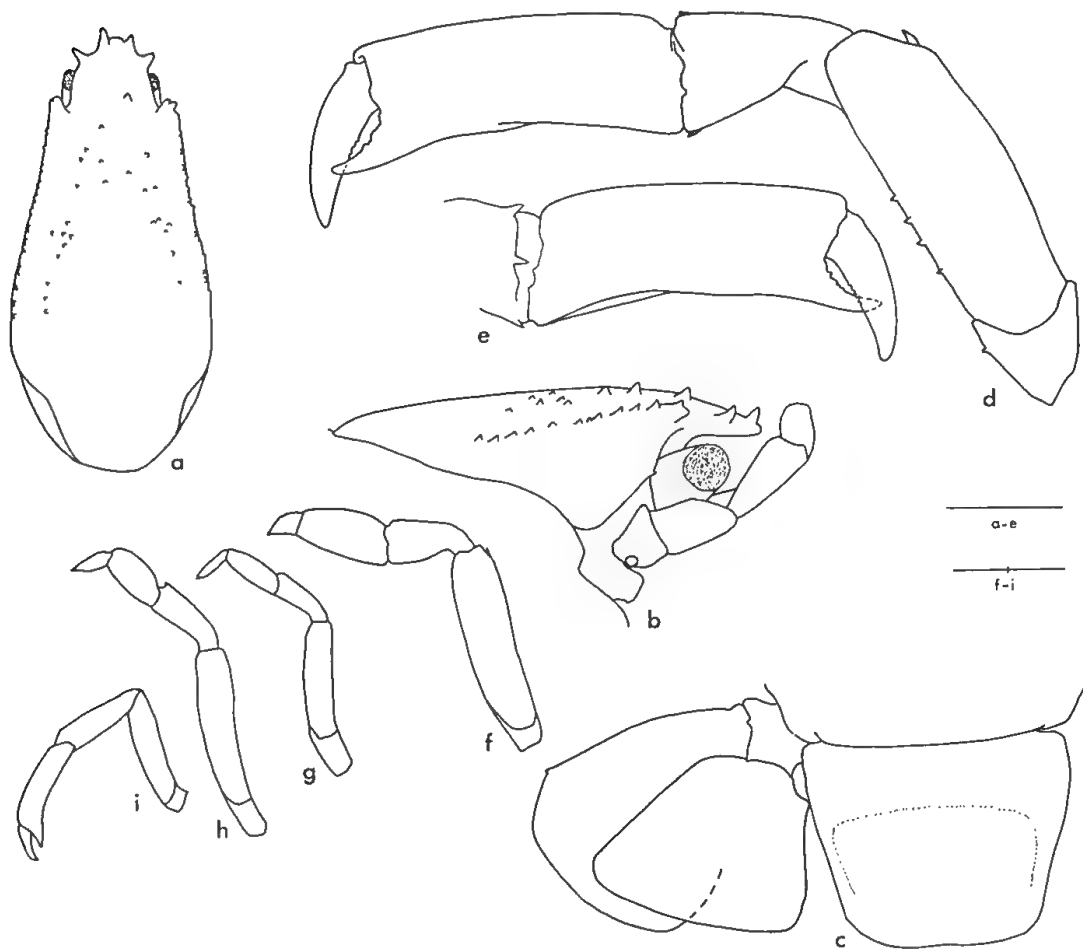


Fig. 46. *Upogebia darwinii* (WAM 32-75, female, 5.7 mm): a, b, dorsal and lateral views of anterior region; c, telson and uropod; d, pereopod 1 (lateral); e, pereopod 1 (medial view of terminal articles); f-i, pereopods 2-5.

Telson wider than long, lateral margins tapering, distal margin broadly curved but slightly concave medially; a strong dorsal transverse ridge $\frac{1}{3}$ way along, passing into 2 submarginal longitudinal ridges. Uropod endopod with straight lateral margin, slightly convex distal margin; exopod lateral margin convex and ending with a small spine, distal margin strongly convex and continuous with medial margin.

DISTRIBUTION: Intertidal to shallow water, in coral cracks, sponges and sandy mud; Red Sea, southeast Asia, northern Australia. See De Man (1928a) for list of localities.

REMARKS: Until recently *Upogebia darwinii* was poorly described but Ngoc-Ho (1977) has given a good description of this rather variable species. The spination of the rostrum and relative lengths of the fingers on pereopod 1 is variable. *U. darwinii* is a small species similar to *U. carinicauda* from which it differs in spination of the rostrum. Ngoc-Ho (1977) discussed variation in this species particularly in the spines of the rostrum and cheliped.

We obtained types of this species from the British Museum (Natural History); three specimens from Darwin (number 82.7) and two syntypes from Singapore (number 82.24).

These could be confused with *U. hexaceras* but are distinguished by much smaller size (cl. about 5 mm), the very broad obtuse medial lobe of the rostrum bearing four blunt teeth and the obsolete lateral lobes of the rostrum. De Man's (1928a) figure of the rostrum of a specimen from the Mergui Archipelago is not consistent with the type specimens.

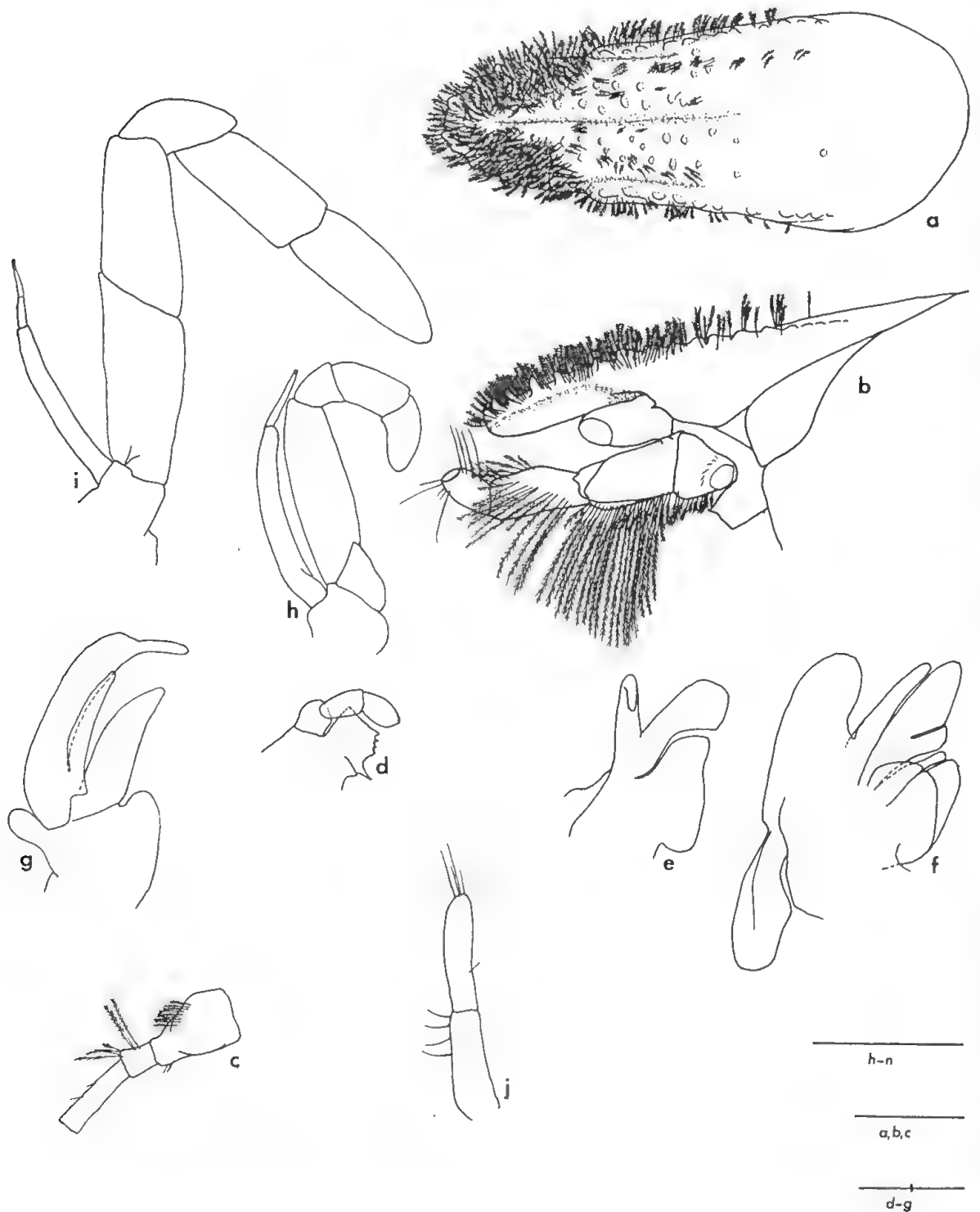


Fig. 47. *Upogebia dromana* (NMV J.304, female, 7.2 mm): a, b, dorsal and lateral views of anterior region; c, antenna 1; d, mandible; e, f, maxillae 1, 2; g-i, maxillipeds 1-3; j, pleopod 1.

Upogebia (Upogebia) dromana n. sp.

Figs 47, 48

MATERIAL EXAMINED: 33 specimens; cl. 5-9 mm.

HOLOTYPE: NMV J.304, female, cl. 7.2 mm.

TYPE LOCALITY: *Victoria*: 2 km W. of Fisherman Point, Mornington, Port Phillip Bay (PPBES stn 972); sandy silt sediment; 19 m; 11 October, 1971.PARATYPES: *New South Wales*: Off Malabar, Shelf Benthic Survey stations: stn II (AM P.24680) 1 spec.; stn 35 (AM P.24691) 1 spec.

Victoria: Port Phillip Bay PPBES stn 906 (NMV J.305) 2 specs; stn 914 (NMV J.306) 2 specs; stn 938 (NMV J.307) 1 spec.; stn 969 (NMV J.308) 2 specs; (AM P.25269) 2 specs; stn 972 (NMV J.309) 2 specs; stn 977 (NMV J.310) 1 spec., (AM P.25270, 1) 3 specs; stn 982 (NMV J.311) 1 spec., (AM P.25272, 3) 5 specs; stn 983 (NMV J.312) 2 specs, (AM P.25274, 5) 2 specs. — Crib Point, Western Port, CPBS stn 31S (NMV J.313, J.314) 2 specs; CPBS stn 300 (NMV J.315) 2 specs.

Tasmania: 8 mi (12.8 km) off Burnie (TM G.1477) 1 spec.

DESCRIPTION: Rostrum not trilobed, depressed distally, as long as wide at base; 4-7 (usually 5 or 6) vertically directed stout spines on each side; sides often not symmetrical; a thick fur of setae on the dorsal surface of the rostrum except near the median groove; without ventral teeth. Dorsolateral margins of the carapace with 10-12 blunt teeth, largest anteriorly, separated from rostral teeth by a distinct but short hiatus. Dorsum tuberculate, posteriorly 2 rows of obsolete tubercles on each side separated by a median groove, more pronounced anteriorly on basal half of rostrum where rows coalesce. Spine on anterolateral border of carapace near eye present, though sometimes minute, but without spines on lateral portion of cervical groove. Eyestalk about half length of rostrum. Maxilliped 3 exopod longer than ischium; ischium with proximally directed hook on mesial face; merus shorter than ischium, together about as long as last 3 articles; dactyl 1.2 times as long as propod. Pereopods 1 equal, not sexually dimorphic; coxa with small distal spine, double ventral setal row on ischium and merus, merus with 4-9 irregularly spaced, perpendicular ventral spines; distal margin of carpus with minute dorsal spine, large mesiodorsal spine and smaller mesial spine; propod without spines; fixed finger 0.2 length of dactyl, minute accessory tooth; dactyl evenly curved, cutting edge irregular; ratio of dorsal lengths — merus: carpus: propod — 1:0.5:0.8. Pereopod 2 carpus with a small dorsal hook; pereopods 3-5 unarmed. Pleopod 1 (female) 2-articulate, second article longer. Pleopod 1 (male) absent. Telson quadrate, length 0.8-0.85 width, with 2 strong curved, transverse ridges on proximal half and fine medial longitudinal groove posteriorly, sometimes crossing second ridge. Uropod endopod triangular with lateral and distal margins straight; exopod longer than endopod, distal margin convex.

Colour yellowish-orange with small widely-spaced red chromatophores.

DISTRIBUTION: Silty-sand to sandy sediments, 10-20 m; New South Wales shelf; Port Phillip Bay and Western Port, Victoria, and north coast of Tasmania.

REMARKS: *U. dromana* is most closely similar to *U. hirtifrons* from New Zealand from which it differs most especially in having two (rather than a single) transverse ridges on the telson. Other minor features shown only by *U. hirtifrons* are a dorsal spine on the ischium of pereopod 1, tubercles on the posterior margin of the cervical groove and more than one dorsal spine on the carpus of pereopod 2.

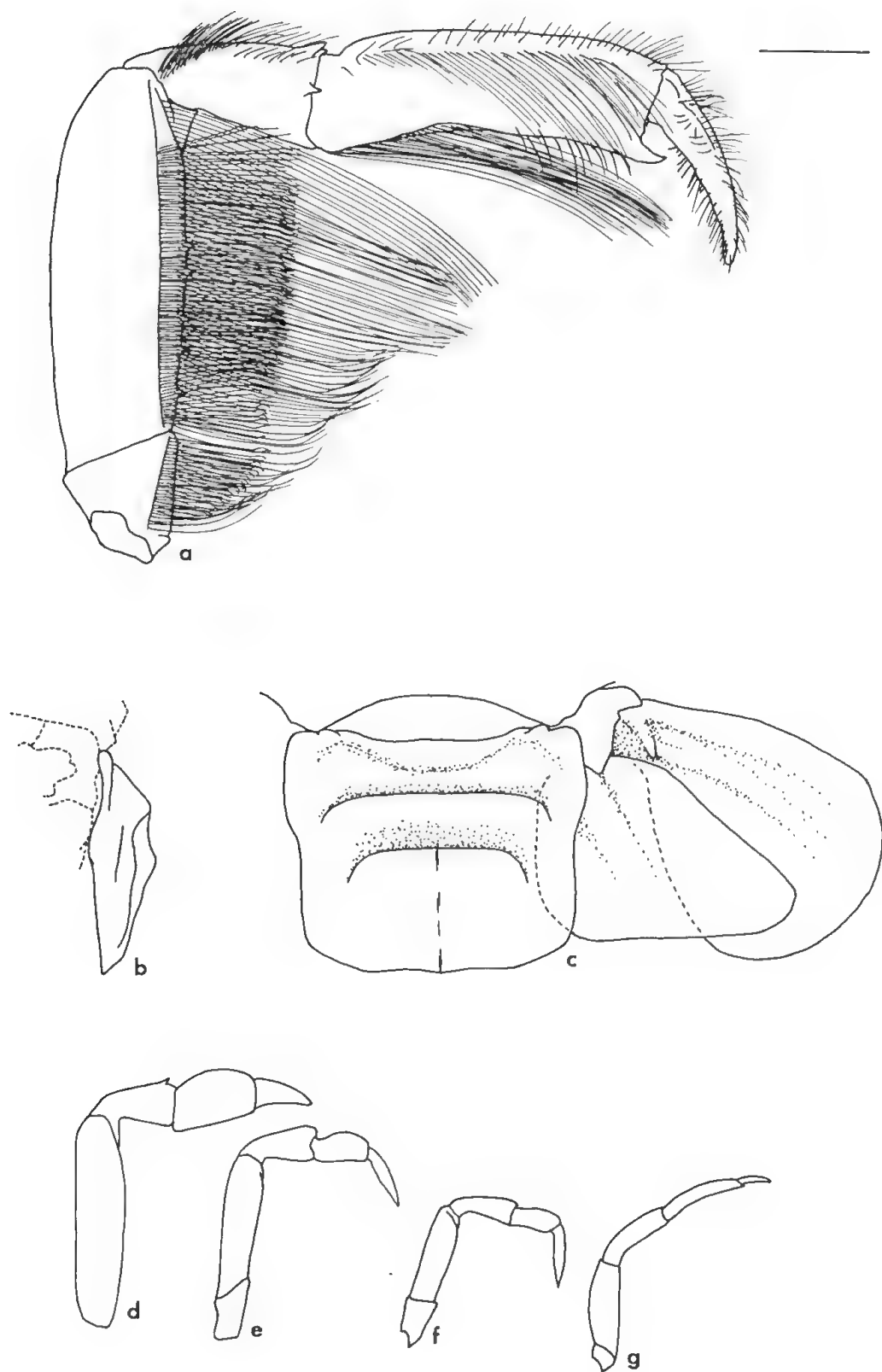


Fig. 48. *Upogebia dromana* (NMV J.304, female, 7.2 mm): a, d-g, pereopods 1-5; b, lateral view of telson; c, telson and uropod.

This species is described largely from quantitative benthic samples from the PPBES (Poore, 1975). Smith-McIntyre grab samples (0.1 m²) indicate a density of up to 16 specimens per square metre.

Upogebia (Upogebia) giralia n. sp.

Fig. 49

MATERIAL EXAMINED: 3 males, 6 females; cl. 6-14 mm.

HOLOTYPE: WAM 123-75, male, cl. 14 mm.

TYPE LOCALITY: *Western Australia*: Learmonth, mangroves; coll: A. M. Douglas and G. F. Mees, 20 May 1960.

PARATYPES: *Western Australia*: Learmonth, collected with holotype (WAM 124-75) 1 spec.

Northern Territory: Tinganoo Creek, Melville Is. (AM P.24806) 6 specs. — Andranangoo Creek, Melville Is. (AM P.24807) 1 spec.

DESCRIPTION: Rostrum barely trilobed, lateral lobes scarcely distinct from medial lobe; medial lobe 0.6 times as long as wide, broadly rounded anteriorly, with 3-4 stout blunt marginal spines distally; dorsolateral margins of carapace with irregular row of blunt spines, terminal one (lateral lobe) separate from more posterior ones, and clearly separate from spines of medial lobe by a short hiatus. Dorsum domed and with a pair of short spines between ends of dorsolateral ridges, setae in two rows of dense tufts and around bases of anterior spines. No spines on anterolateral edge of carapace or on cervical groove. Eyestalk less than half length of rostrum. Maxilliped 3 exopod longer than ischium; ischium with a hook on mesial face, merus about as long as ischium and together about as long as last 3 articles. Pereopods 1 equal; double ventral setal row on ischium and merus; ischium with 1 ventral spine; merus with 2-3 (none in small specimen) ventral and 1 distal dorsal spine; carpus with 2 distal dorsal spines and 1 distal medial spine; propod serrate dorsally, proximally denticulate ventrally, with a strong medial spine at the base of the fixed finger and another laterally in the gape; fixed finger 0.4-0.6 length of dactyl, stout, cutting edge irregularly serrate; dactyl evenly curved, cutting edge irregularly dentate, with a medial row of tubercles; ratio of dorsal lengths — merus: carpus: propod — 1:0.6:1. Pereopod 2 merus with a dorsal spine; pereopods 3-5 unarmed. Pleopod 1 (female) 2-articulate, second article shorter than first. Pleopod 1 (male) absent. Telson wider than long, widest at about ¼ length and tapering, posterior margin concave, dorsally smooth. Uropod endopod strongly expanded distally, shorter than telson, lateral margin straight, distal and medial margins convex and continuous; exopod longer than endopod, lateral margin slightly convex, distal margin strongly convex.

DISTRIBUTION: Intertidal in mangroves; north and western Australia.

REMARKS: *U. giralia* is one of only two species of this genus known from Australia in which the lateral lobes of the rostrum are obsolete. The other is *U. dromana* from southeastern states which differs in having a more tapered rostrum, transverse carinae on the telson and in a number of other features. The form of the rostrum of *U. giralia* is similar to that of *U. osiridis* Nobili from the Red Sea (De Man, 1927) but they differ in detail and in the dentition of pereopod 1. *U. giralia* is most clearly recognized and distinguished from other species of the genus by the concentration of setae into dense tufts on the dorsum of the carapace and along the margin of the rostrum.

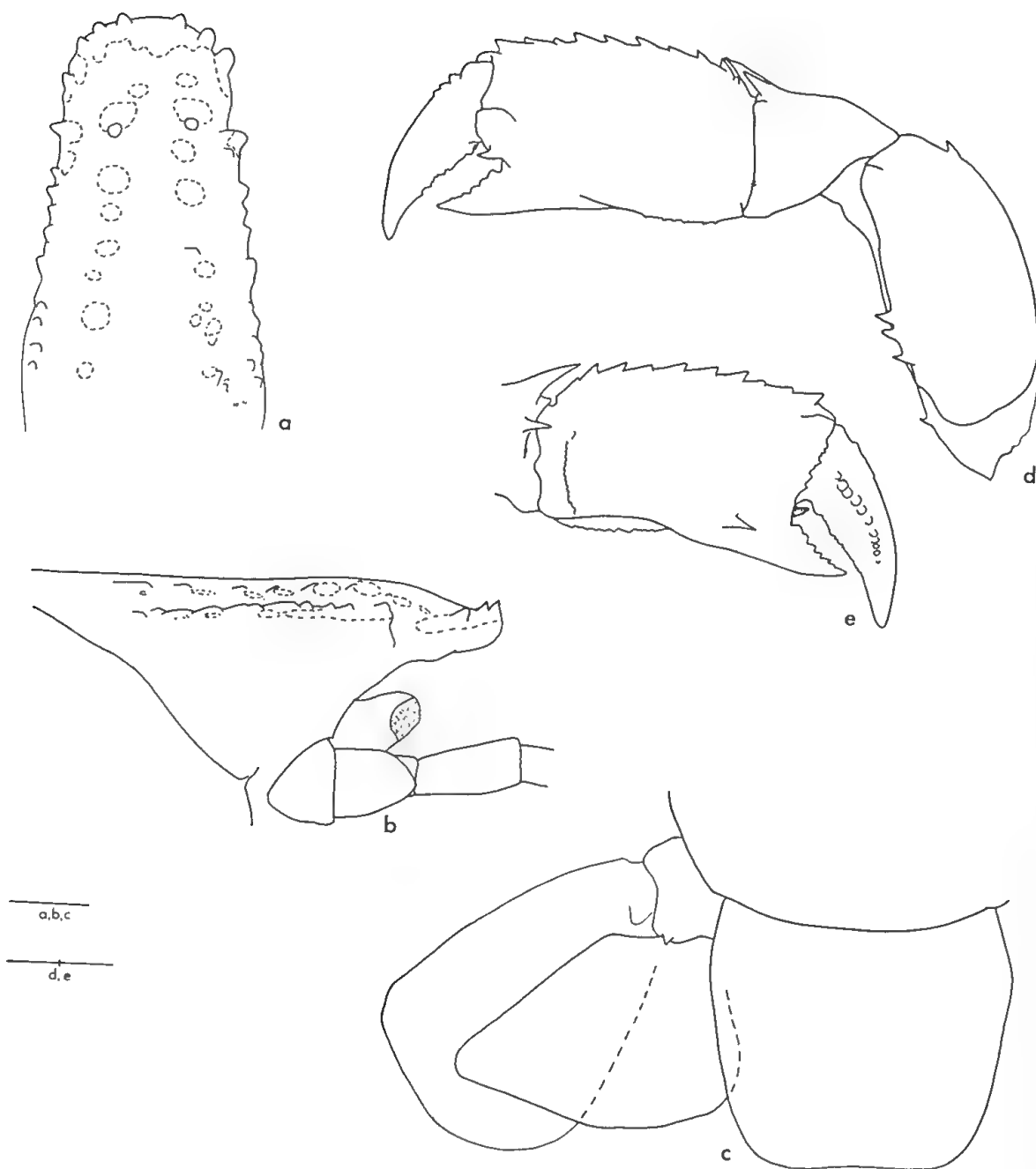


Fig. 49. *Upogebia giralia* (WAM 123-75, male, 14 mm): a, b, dorsal and lateral views of anterior region (dashed areas denote limits of dorsal tufts of setae); c, telson and uropod; d, pereopod 1 (lateral); e, terminal articles of pereopod 1 (medial).

Upogebia (Calliadne) hexaceras (Ortmann)

Fig. 50

Gebia (Gebiopsis) hexaceras Ortmann, 1894: 23, pl. 3 fig. 1 (type locality: Thursday Island, Queensland).

Upogebia (Calliadne) hexaceras. — Nobili, 1906: 60. — De Man 1928a: 24, 49, 81-84, pl. 7 figs 11-11f.

MATERIAL EXAMINED: 7 males, 6 females; cl. 8-15 mm.

Northern Territory: Darwin (AM P.6823) 2 specs.

Queensland: Gulf of Carpentaria, CSIRO Prawn Survey (AM P.24681) 1 spec.

Western Australia: 4.8-7.2 km E. of Pilambri Is., Dampier Archipelago (WAM 121-75) 1 spec. — between Gridley and Rosemary Is., Dampier Archipelago (WAM 156-65) 1 spec. — Exmouth Gulf (WAM 28-75) 1 spec. — Cottlesloe (WAM 10573) 1 spec. — Bunbury (AM P.24685) 2 specs. — locality unknown (WAM 65-75) 2 specs. — locality unknown (WAM 87-53) 2 specs.

DESCRIPTION: Rostrum trilobed, hiatus a broad V, lateral lobes $\frac{1}{4}$ length of medial lobe, reaching forward less than halfway to most posterior of tubercles of the medial lobe; total length $\frac{2}{3}$ of width at base; surface of medial lobe weakly tuberculate except along grooved midline, lateral edge of medial lobe with 2 or 3 tubercles; lateral lobes with tubercles on edge extending back almost to cervical groove, tubercles getting smaller posteriorly; a dense fur of setae covering medial lobe, scattered setae along edges of lateral lobes; without ventral teeth. No spine on anterolateral border of carapace; posterior border of cervical groove smooth. Eyestalk about 0.6 length of rostrum. Maxilliped 3 exopod reaching forward to midway along merus of endopod; ischium without hook, ischium and merus together about as long as last 3 articles; dactyl almost as long as propod. Pereopods 1 equal, not sexually dimorphic; double ventral setal row on merus; single ventral row of setae on propod; ischium with 1-2 ventral denticles on larger specimens; merus with denticles along entire length of ventral mesial edge, otherwise smooth or rarely with obsolete dorsal spine; distal edge of carpus with 4-5 short mesial denticles and several short dorsal spines; propod with few small denticles ventrally, mesial surface with 2-3 small denticles and lateral surface with 1-2 denticles near base of fixed finger. Fixed finger and dactyl subequal; fixed finger cutting edge finely toothed especially proximally; dactyl strongly curved, cutting edge with strong tooth proximally, dorsal surface with obsolete proximal tubercles; ratio of dorsal lengths — merus: carpus: propod — 1:0.2:1. Pereopods 2-5 unarmed. Pleopod 1 (female) 2-articulate, articles subequal. Pleopod 1 (male) absent. Posterior edge of sixth abdominal segment denticulate. Telson subquadrate, 1.3 times as wide as long, lateral edges straight, slightly tapering, distal edge convex but weakly concave at midline, surface with a weakly spinulose, transverse ridge close to base, spinulose domes posterior to this, longitudinal ridge near each lateral edge. Uropod endopod shorter than telson, lateral edge weakly convex, minutely denticulate, distal edge straight, surface with single longitudinal ridge; exopod little longer than endopod, distal edge weakly convex, minutely denticulate, surface with 2 longitudinal ridges.

DISTRIBUTION: Intertidal — 20 m, associated with sponges; north Queensland, Northern Territory, Western Australia; Persian Gulf (Nobili, 1906), Salawati Is., Indonesia (De Man, 1928a).

REMARKS: The two specimens from north of Australia described by De Man (1928a) have 3 spines on each side of the medial lobe of the rostrum. In our collection specimens

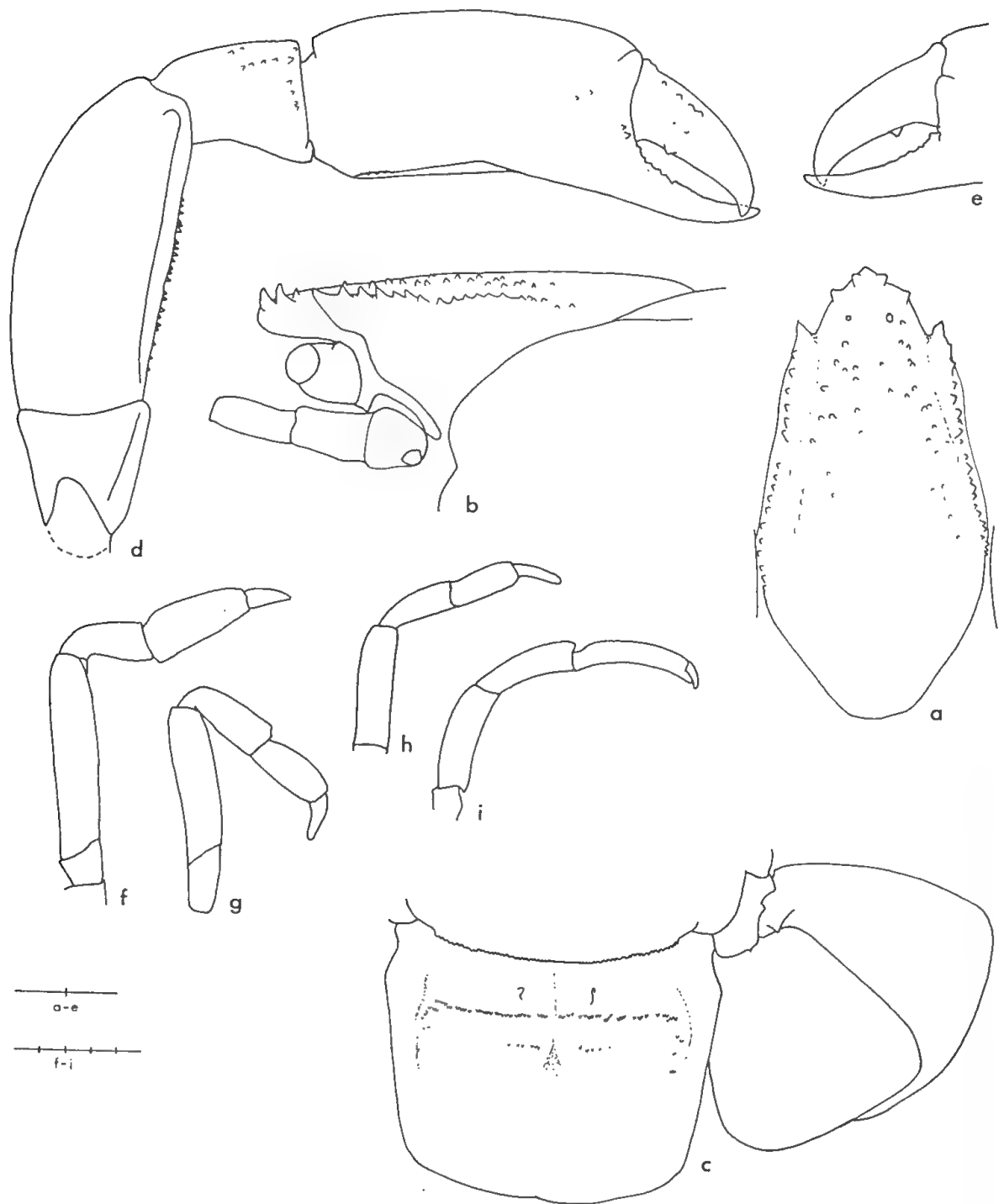


Fig. 50. *Upogebia hexaceras* (WAM 10573, female, 14 mm): a, b, dorsal and lateral views of anterior; c, telson and uropod; d, pereopod 1; e, chela (lateral); f-i, pereopods 2-5.

with 2 spines were equally common. De Man (1928a) did not note the small medial tubercles on the distal margin of the propod of pereopod 1, consistent in our material. *U. hexaceras* is distinguished from similar Australian species with short lateral lobes by the prominent tubercles on the triangular medial rostrum lobe and the spination of pereopod 1.

***Upogebia (Upogebia) neglecta* De Man**

Fig. 51

Upogebia neglecta De Man, 1927: 34-36, fig. 13 (type locality: Port Stephens, N.S.W.); 1928a: 23, 42.

MATERIAL EXAMINED: 1 female; cl. 15 mm.

New South Wales: Port Stephens (AM P.1545 holotype) 1 spec.

DESCRIPTION: Rostrum trilobed, lateral lobes slender, 0.3 length of medial lobe, hiatus between lobes a narrow V, total length 1.4 times width at base; medial lobe tuberculate except anteriorly along shallow medial groove; lateral lobes with closely spaced tubercles along lateral edge; surfaces very sparsely setose; without ventral teeth. A spine on anterolateral border of carapace near eye. Posterior border of cervical groove tuberculate towards dorsal surface. Eyestalk about half length of rostrum. Maxilliped 3 exopod reaching halfway along merus; ischium with a proximally-directed hook on mesial face and medial row of short tubercles; merus as long as ischium, merus and ischium together about as long as last 3 articles; dactyl 1.2 times as long as propod. Pereopods 1 equal, double ventral setal row on ischium and merus; ischium with 3 ventral spines; merus with 4-6 irregularly-spaced, ventral spines and a subdistal dorsal spine; distal margin of carpus with a strong, curved ventral spine, a slightly shorter dorsal spine and 2 smaller subdorsal lateral spines; propod with ventral denticles proximally, a subdistal dorsal spine, 2 mesial distal spines and 1 lateral distal spine; fixed finger 0.2 length of dactyl, with minute teeth proximally on cutting edge; dactyl slender, dorsally denticulate, with a lateral ridge, cutting edge weakly denticulate; ratio of dorsal lengths — merus: carpus: propod — 1:0.5:0.9. Pereopods 2, 3 with spines on merus and carpus; pereopods 4, 5 unarmed. Pleopod 1 (female) 2-articulate, second article longer. Telson quadrate, length 0.8 width, surface smooth. Uropod endopod with single longitudinal ridge, lateral and distal margins straight; exopod with double ridge, longer than endopod, distal edge evenly convex; distal edges of endopod and exopod minutely denticulate.

DISTRIBUTION: New South Wales.

REMARKS: This specimen, the only one known of the species, was extensively described by De Man (1927). The species is similar to *U. simsoni*, whose distribution includes the only known locality of *U. neglecta*, in having prominent lateral lobes on the rostrum. They also share a mesial row of teeth, less pronounced in this species, on the ischium of maxilliped 3, (see comments under *U. simsoni*). The two species can be distinguished by the spination of the pereopod 1, and shape of the telson and rostrum.

***Upogebia (Upogebia) simsoni* (Thomson)**

Fig. 52

Gebia simsoni Thomson, 1893: 49-50, pl. 1 figs 3-5 (type locality: Tasmania).

Upogebia simsoni. — Fulton & Grant, 1902: 61-64, pl. 5 figs 5, 6 — Hale, 1927: 85. — De Man, 1927: 24-25; 1928a: 23, 40.

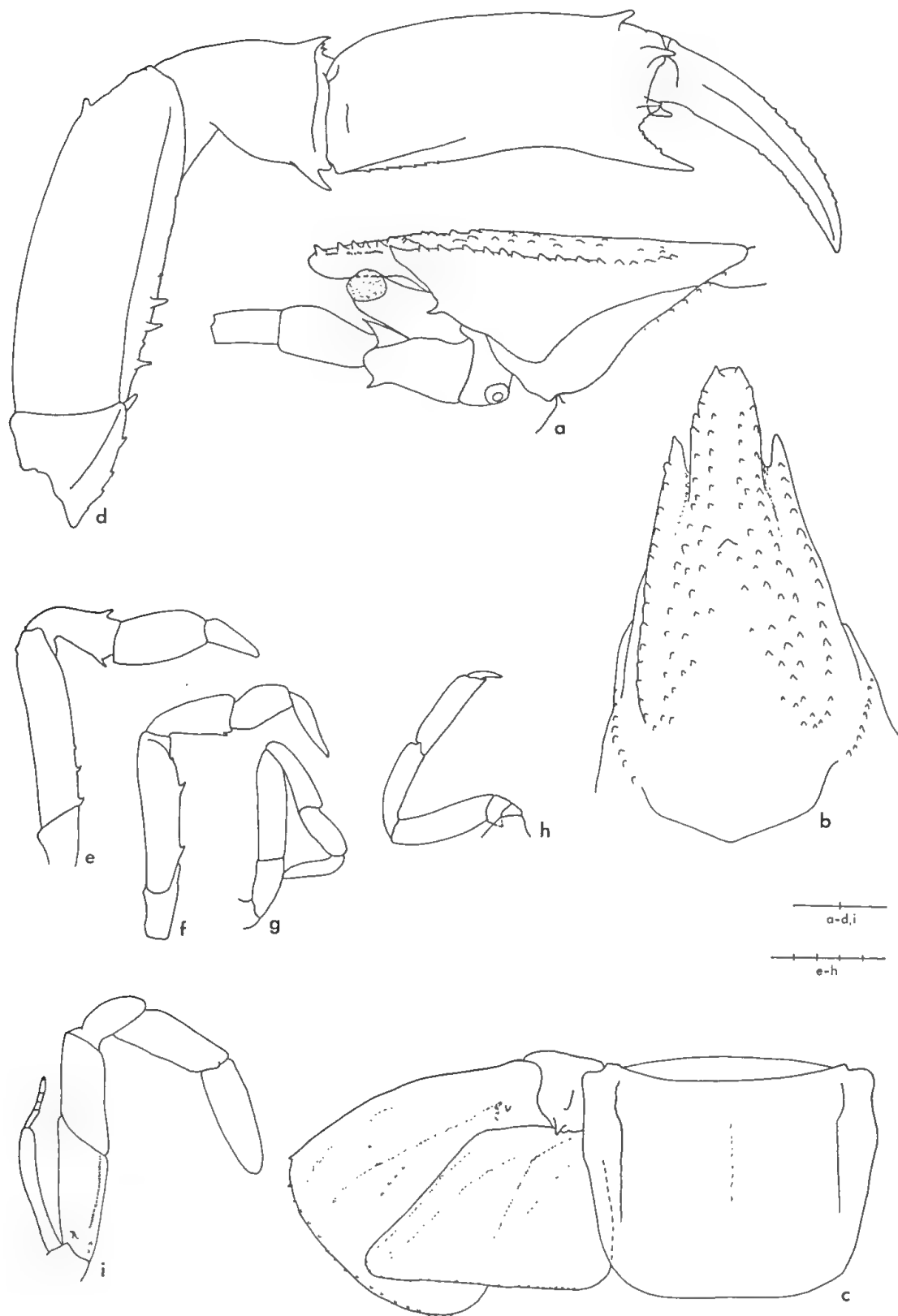


Fig. 51. *Upogebia neglecta* (AM P.1545, female, 16 mm): **a**, **b**, dorsal and lateral views of anterior region; **c**, telson and uropod; **d-h**, pereopods 1-5; **i**, maxilliped 3.

MATERIAL EXAMINED: 47 specs; cl. 11-40 mm.

Northern Territory: Port Darwin (AM P.9478) 1 spec.

Queensland: Northwest Island, Capricorn Group (NMV) 1 spec.; (AM P.8678) 1 spec.

New South Wales: Long Reef, Collaroy (AM P.7473) 1 spec. — Port Jackson (AM P.1407) 2 specs. — Bottle and Glass Rocks, Port Jackson (AM P.9417) 1 spec.; (AM P.8696) 1 spec. — Kurnell, Botany Bay (AM P.9055) 11 specs; (AM P.8943) 14 specs. — Shellharbour (AM P.9361) 1 spec.; (AM P.7901) 2 specs.

Victoria: Flinders (NMV) 1 spec.; (NMV, Kane colln) 1 spec.

Tasmania: No locality (AM P.5970) 2 specs. — Fisher Is., Furneaux Group (TM G.1638) 1 spec. — Margate (T. M. Walker colln) 1 spec.

South Australia: Kangaroo Island (AM P.150) 2 specs. — Kingscote, Kangaroo Island (AM P.4825) 2 specs; (AM P.4842) 1 spec.

DESCRIPTION: Rostrum strongly trilobed, lateral lobes reaching to midpoint of medial lobe, hiatus between lobes a broad U, all 3 lobes weakly upcurved apically, total length equal to width at base; up to 10 vertically directed stout spines along each side of medial lobe and up to 14 on lateral edge of lateral lobes, spines on rostrum continuing back to near cervical groove; a few stout setae on dorsal surface of the rostrum scattered among spines and arising in rows below lateral teeth; ventral teeth absent. Without a spine on anterolateral border of carapace; posterior border of cervical groove weakly tuberculate. Eyestalks narrow, about half length of rostrum. Maxilliped 3 exopod reaching to midway along merus of endopod; ischium of endopod with mesial row of slender spines on inner surface; merus almost as long as ischium, its medial edge with strong spines along central $\frac{2}{3}$; ischium and merus together about as long as last 3 articles; dactyl almost as long as propod. Pereopods 1 equal, not sexually dimorphic, single sparse setal row on ischium and merus; ischium with 2-3 ventral spines; merus with 2-4 ventral spines proximally, a distal dorsal spine and lateroventral tuberculate ridge; distal margin of carpus with strong ventral spine and 2 mesiodorsal spines; propod with 3-7 spines ventrally near base of fixed finger and a small dorsal spine close to distal edge; fixed finger 0.2 length of dactyl, cutting edge serrate proximally; dactyl tapering, dorsally serrate; ratio of dorsal lengths — merus: carpus: propod — 1:0.6:1.2. Pereopods 2, 3 with small ventral denticles on the merus; pereopods 4, 5 unarmed. Pleopod 1 (female) 2-articulate, articles subequal in length. Pleopod 1 (male) absent. Telson subquadrate, proximal half of equal width throughout, distal half narrowing somewhat, length about 0.8 width, surface smooth, distal edge weakly concave. Uropod endopod with single longitudinal ridge, lateral edge straight, distal edge weakly convex, minutely spinose; exopod with double ridge, longer than endopod, distal edge convex, minutely spinose.

DISTRIBUTION: Intertidal to high subtidal; Northern Territory, eastern Australian coast, Tasmania, through to eastern South Australia.

REMARKS: Thomson's original description was extremely brief mentioning only the general features of the rostrum, antennae and first pereopods. Fulton & Grant (1902) extensively redescribed the species on the basis of material from Western Port with which our specimens agree well.

This species is notable among *Upogebia* in having a mesial row of teeth on the ischium of maxilliped 3. This feature is generally present in species of *Callinassa* and axiids, being replaced in *Upogebia* most commonly by a single proximal hook. The absence of this

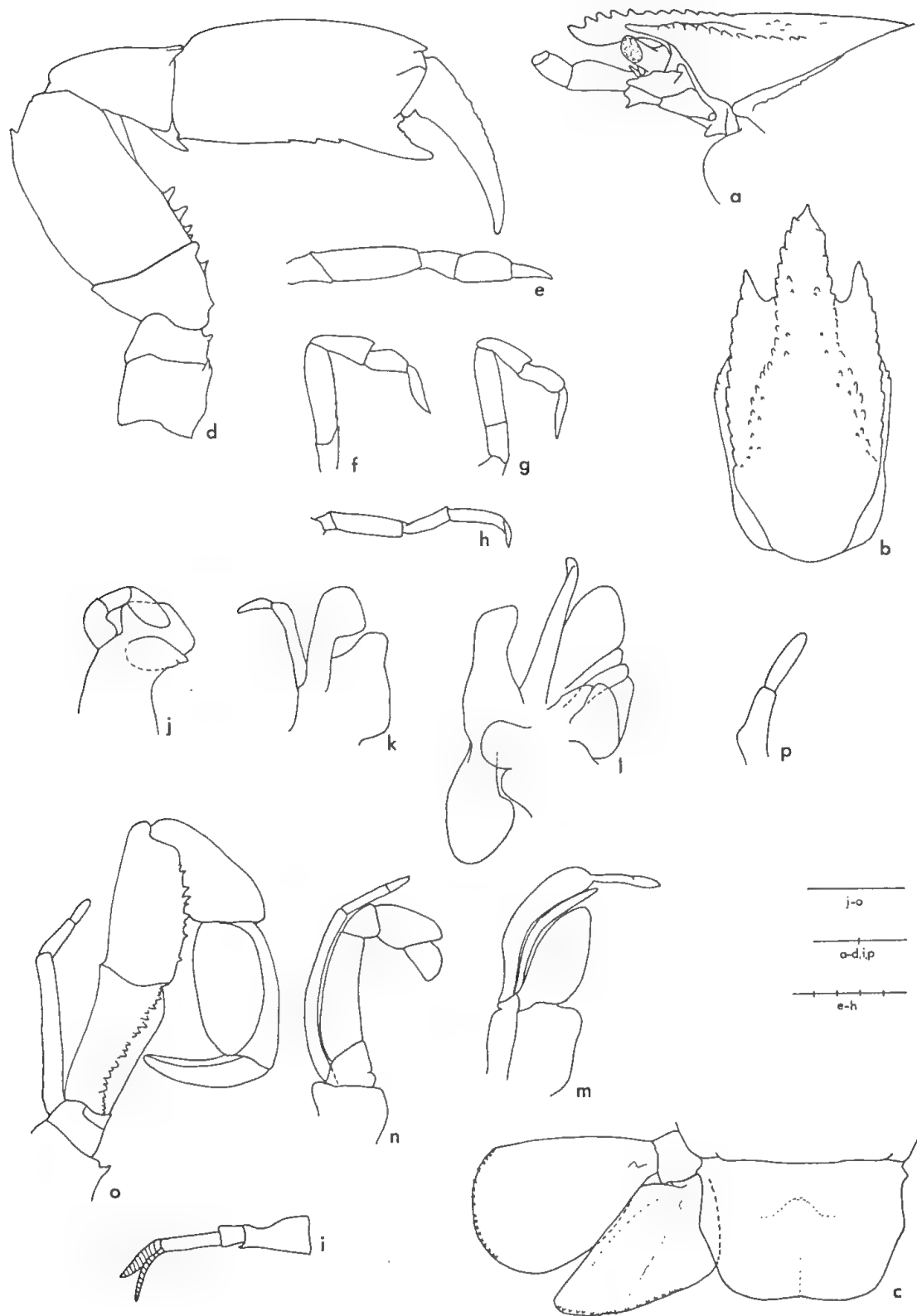


Fig. 52. *Upogebia simsoni* (AM P.8943, female, 11 mm): a, b, dorsal and lateral views of anterior region; c, telson and uropod; d-h, pereopods 1-5; i, antenna 1; j, mandible; k, l, maxillae 1, 2; m-o, maxillipeds 1-3. (AM P.8943, female, 13 mm): p, pleopod 1.

toothed ridge, the *crista dentata*, was used by de Saint Laurent (1973) in the diagnosis of the family Upogebiidae but we cannot remove *U. simsoni* from the family on the basis of this character alone.

Upogebia (Upogebia) spinifrons (Haswell)

Figs 53, 54

Gebia spinifrons Haswell, 1881: 762 (type locality: Port Stephens, N.S.W.); 1882: 165, pl. 3 fig. 5.

Upogebia spinifrons. — De Man, 1927: 53-56, pl. 6 fig. 20; 1928a: 23, 46.

MATERIAL EXAMINED: 25 specs; cl. 9-25 mm.

Queensland: Gulf of Carpentaria, CSIRO Prawn Survey stn 29 (AM P.24682) 1 specs.; stn 558 (AMP.24683) 2 spec; stn 13 (AMP.24684) 1 specs. — Mud Island, Moreton Bay (QM W.1218) 2 specs; (QM W.1234) 1 spec.; (QM W.1435) 3 specs. — Moreton Bay (QM W.1071) 1 spec.; (QM W.2585) 1 spec.; (QM W.2765) 1 spec. — ½ mi SE. of Southwest Rocks, Moreton Bay (QM W.3968) 1 spec.; (QM W.3969) 1 spec. — Macleay Is., Moreton Bay (QM W.2892) 1 spec.

New South Wales: Port Stephens (AM P.261) 2 specs; (AM P.1544) 1 spec. — Hawkesbury River, near Brooklyn (AM P.12943) 1 spec. — Port Jackson (AM P.11448) 1 spec. — Potts Point, Port Jackson (QM W.1535) 4 specs.

DESCRIPTION: Rostrum strongly trilobed, lateral lobes reaching to midpoint of medial lobe, hiatus a narrow U, as long as width at base, dorsally with a few marginal tubercles on medial lobe, ventral surface of medial lobe with 4 strong slender spines, ventral surface of lateral lobes each with 1 spine and a terminal spine; a thick fur of setae on dorsal surface of the rostrum except posteriorly. Anterolateral border of carapace with 5 strong spines, 3 above and 2 below antenna 2, 1-2 spines laterally behind eye and 2-3 spines and 3-4 spinules on posterior border of cervical groove. Eyestalks about half length of rostrum. Maxilliped 3 exopod hardly surpassing ischium; ischium with 3 hooks proximally on mesial face and row of short spines medially; merus little shorter than ischium, merus and ischium together about as long as last 3 articles; dactyl slightly longer than propod. Pereopods 1 equal, not sexually dimorphic; coxa with small distal hook; double ventral setal row on ischium and carpus, single row on proximal half of propod; ischium with 4 strong ventral spines; merus with about 8 regularly spaced, strong, ventral spines and one dorsal spine distally; distal margin of carpus with strong, hooked ventral spine, 6-8 large mesiodorsal spines and a large mesial spine; propod with up to 10 strong dorsal spines and 1-2 mesial spines and 1 lateral spine on distal edge; fixed finger 0.1-0.5 length of dactyl, smooth or with accessory lateral tooth; dactyl with proximal tooth on cutting edge, dorsally denticulate proximally; ratio of dorsal lengths — merus: carpus: propod — 1:0.4:0.8. Pereopod 2 with strong hooks on coxa, merus and carpus; pereopod 3 with hooks on merus; pereopods 4, 5 not armed. Pleopod 1 (female) 2-articulate, articles equal in length. Pleopod 1 (male) absent. Telson quadrate, length 0.7 width, with longitudinal groove in midline. Uropod endopod with single longitudinal ridge, lateral and distal edges almost straight, lateral edge with small lobe near base; exopod longer than endopod with double ridge, distal edge convex.

DISTRIBUTION: 12-25 m; northern Queensland to central New South Wales.

REMARKS: The extremely spinous rostrum, carapace, antennae and chelipeds distinguish this species from others of the genus in Australia. It has been well described and illustrated by De Man.

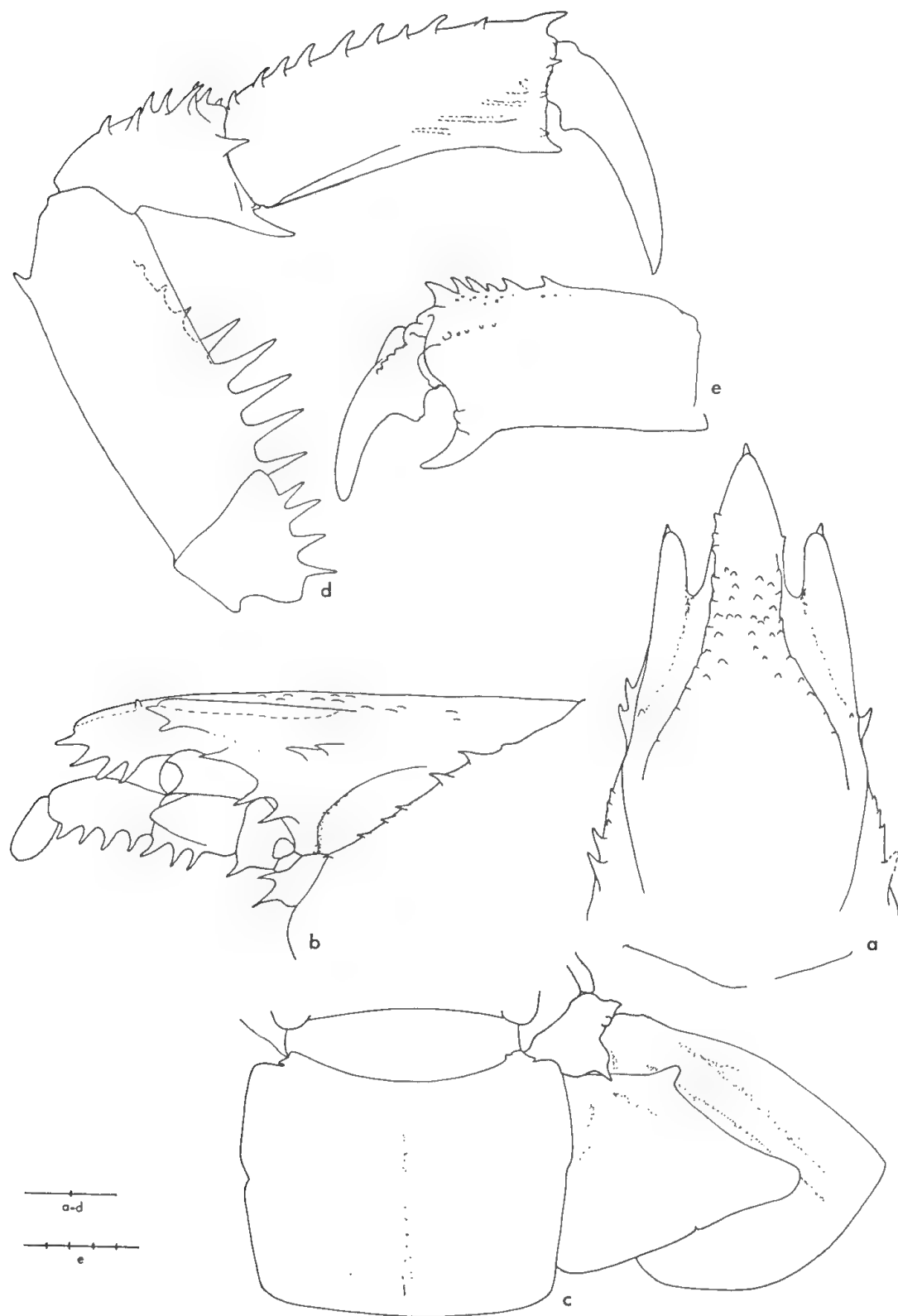


Fig. 53. *Upogebia spinifrons* (AM P.12943, female, 19 mm): a, b, dorsal and lateral views of anterior region; c, telson and uropod; d, pereopod 1. (QM W.1435, female, 24 mm): e, propod and dactyl of pereopod 1 (lateral).

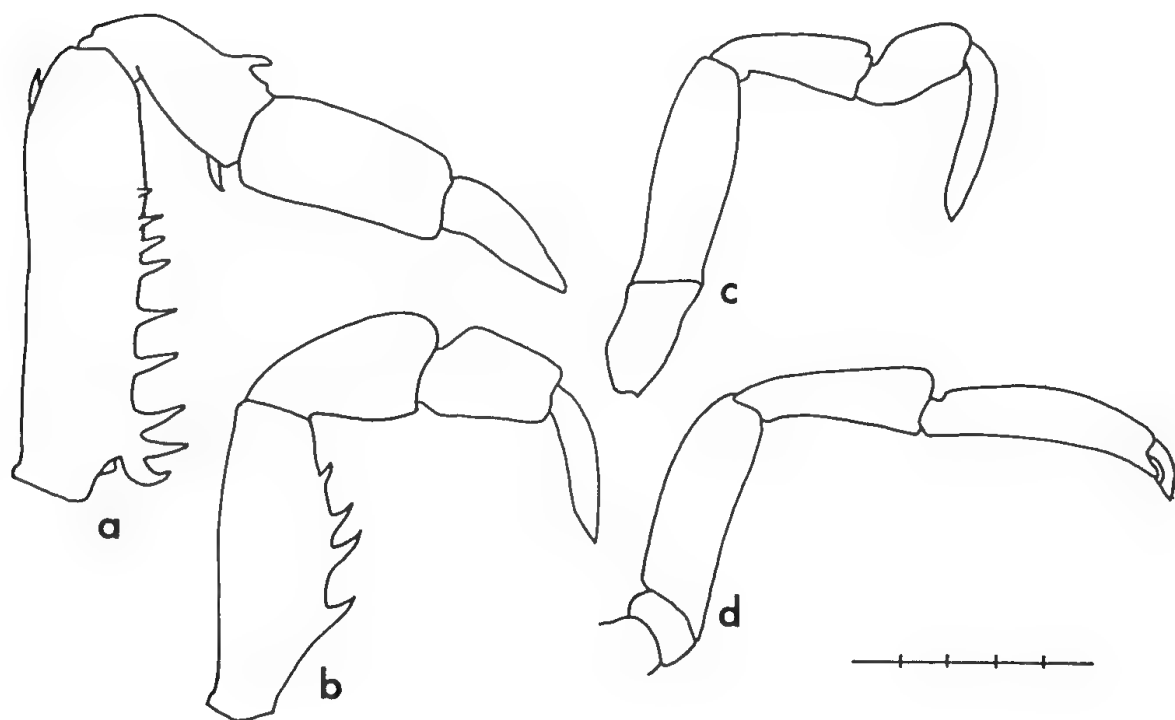


Fig. 54. *Upogebia spinifrons* (AM P.12943, female, 19 mm): a-d, pereopods 2-5.

***Upogebia (Calliadne) tractabilis* Hale**

Fig. 55

Upogebia (Calliadne) tractabilis Hale, 1941: 276-277, fig. 11 (type locality: St Vincent Gulf, S.A.).

MATERIAL EXAMINED: 9 males, 12 females; cl. 3-8 mm.

South Australia: St Vincent Gulf, 57 m (SAM C887 paratypes) 7 specs. — Spencer Gulf (AM P.25289) 2 specs.

Western Australia: Cottesloe (WAM 9992) 1 spec.; (WAM 10639) 2 specs. — NW. of W. end of Rottnest Island, 67 m (WAM 53-75) 3 specs. — Bunbury (AM P.24686) 6 specs.

DESCRIPTION: Rostrum trilobed; medial lobe 3 times as broad as long, bluntly rounded and depressed anteriorly, with 5-7 small submarginal spines on anterior 2/3 of each side, usually vertical but most distal pairs sometimes projecting forwards; lateral lobe about 0.2 length of medial lobe and separated from it by a very shallow smooth U, with a small terminal, somewhat laterally-directed tooth and 4-5 widely spaced small spines along dorsolateral margins of carapace. Dorsum with sparse minute spines anteriorly except along midline; sparsely setose dorsally but dense along ventral edge of medial lobe of rostrum. No spine on anterolateral edge of carapace or on cervical groove. Eyestalk 1.3 times as long as rostrum and clearly visible from dorsal view. Maxilliped 3 exopod longer than ischium; ischium with hook on mesial face; merus about as long as ischium, together about as long as last 3 articles. Pereopods 1 equal, not sexually dimorphic; double ventral setal row on ischium and merus; merus with 5-8 ventral spines; carpus with distal ventral spines; propod with 2 ventral spines proximally and sometimes 1 dorsally; fixed finger

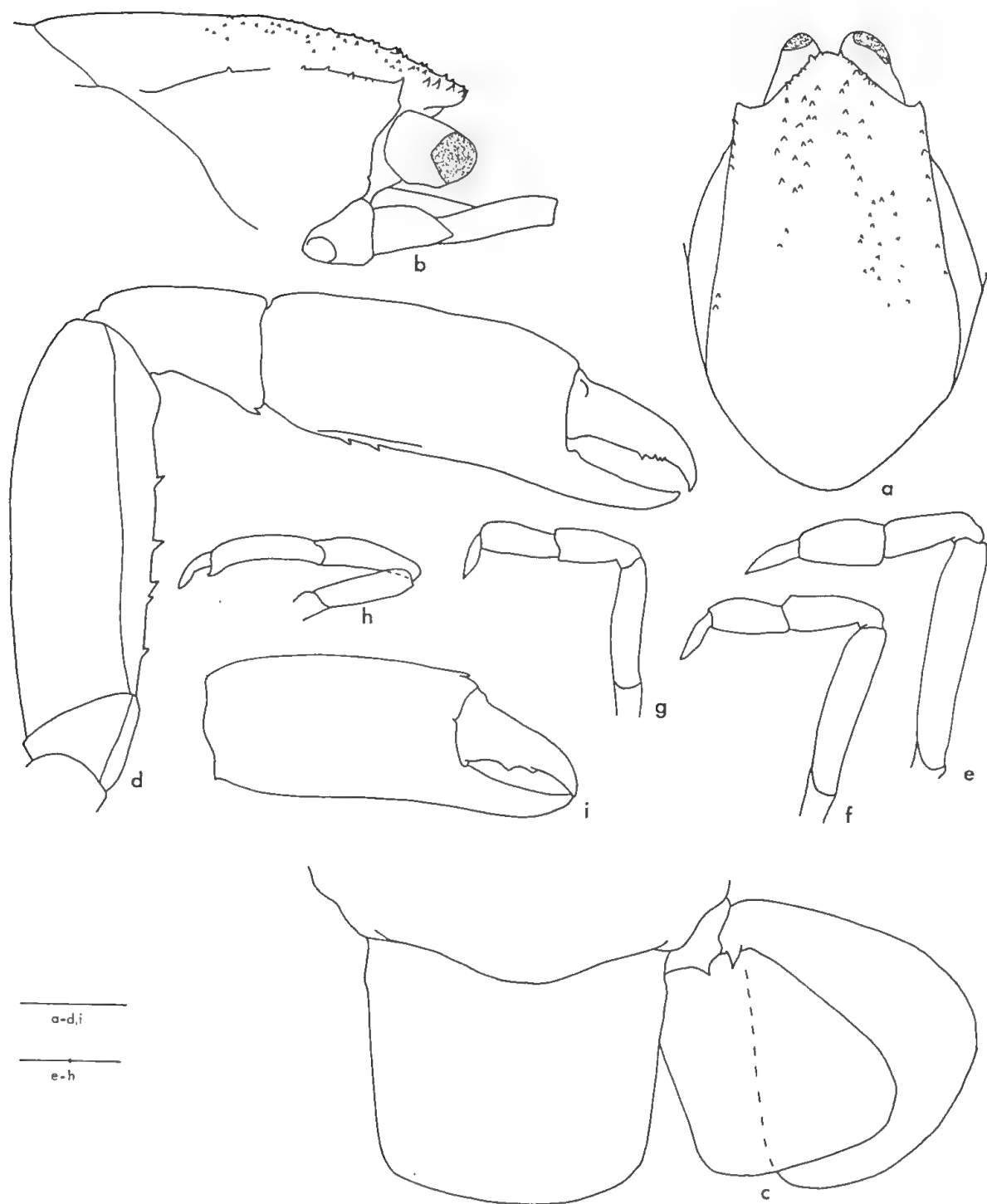


Fig. 55. *Upogebia tractabilis* (SAM C.887, female, 7 mm): a, b, dorsal and lateral views of anterior region; c, telson and uropod; d-h, pereopods 1-5. (SAM C.887, male, 6 mm): i, chela.

curved; dactyl little longer than fixed finger, strongly curved distally, cutting edge usually with 2 proximal teeth but teeth variable in number (up to 5) and position; ratio of dorsal lengths — merus: carpus: propod — 1:0.4:0.8. Pereopods 2-5 unarmed. Pleopod 1 (female) 2-articulate, second article shorter. Pleopod 1 (male) absent. Telson wider than long, lateral margins straight, slightly tapering, posterior margin weakly convex, dorsally smooth. Uropod endopod barely expanded distally, margins almost straight but corners broadly rounded; exopod with continuous, convex lateral and distal margins.

DISTRIBUTION: Often associated with sponges, down to 75 m; St Vincent Gulf (S.A.) to Rottnest Island (W.A.).

REMARKS: This species was adequately figured by Hale but we show here some of the variability of the chela and figure the tail fan for the first time. The species is most clearly recognized by its small size and very short rostrum with only minute spines. It is probably most easily confused with *U. australiensis* from which it differs in the absence of spines around the gape of the chela and the more rounded rostrum.

DISCUSSION

When these studies began a mere 20 species belonging to seven genera were known to occur in Australia. Two new species were described by Poore (1975) and the present report adds three genera new to Australia and a further 18 species of which 12 are new species and six are species previously unknown from Australia. In addition, one species, *Callianidea leura* n. sp., adds a new family to the fauna (table 1). A study of an essentially littoral or shelf decapod crustacean group which doubles the number of known species must be considered unusual. Recent studies of deep-water decapods off Australian coasts have increased the known fauna by a similar order of magnitude.

While extending our knowledge of the fauna the material available to us still leaves a large number of species poorly known. Only 25 of the 40 species are known from more than three localities; material of *Upogebia carinicauda* (Stimpson) from Thursday Island does not exist in Australia and a number of other species are known from only one or two specimens. Collections in the Australian Museum, Western Australian Museum and by the Ministry for Conservation, Victoria, have contributed significantly to the increase of knowledge of the thalassinidean fauna: they contain representatives of all but three of the 20 new species and new records.

Zoogeographic analysis of the Australian thalassinidean fauna is constrained by the paucity of knowledge concerning 15 species. The following discussion draws principally on the 25 better known species.

The fauna appears to be partitioned into five groups (fig. 56): a northern group extending south along the east coast (comprising three species), a northern group extending south along the west coast (five species), a southern group extending eastwards (six species including *Upogebia australiensis* with a disjunct distribution), and an eastern group (mainly southern) (10 species); in addition, 1 species — *Thalassina squamifera* — has a northern distribution extending southwards along both the east and west coasts.

Considering the total fauna the species must be considered rather localized in their distributions, 30 species being confined to either the northeast, southeast, southwest, northwest or north (Torres Strait and the Gulf of Carpentaria). Considering these regional faunas, that occurring in southeastern Australia appears particularly restricted, 11 of the 15 species occurring there being unknown elsewhere; this compares with the northeastern area with only five of the 14 species being so restricted and the southwestern area with four of the 11 being restricted. Again only four species of the Australian total have a wide

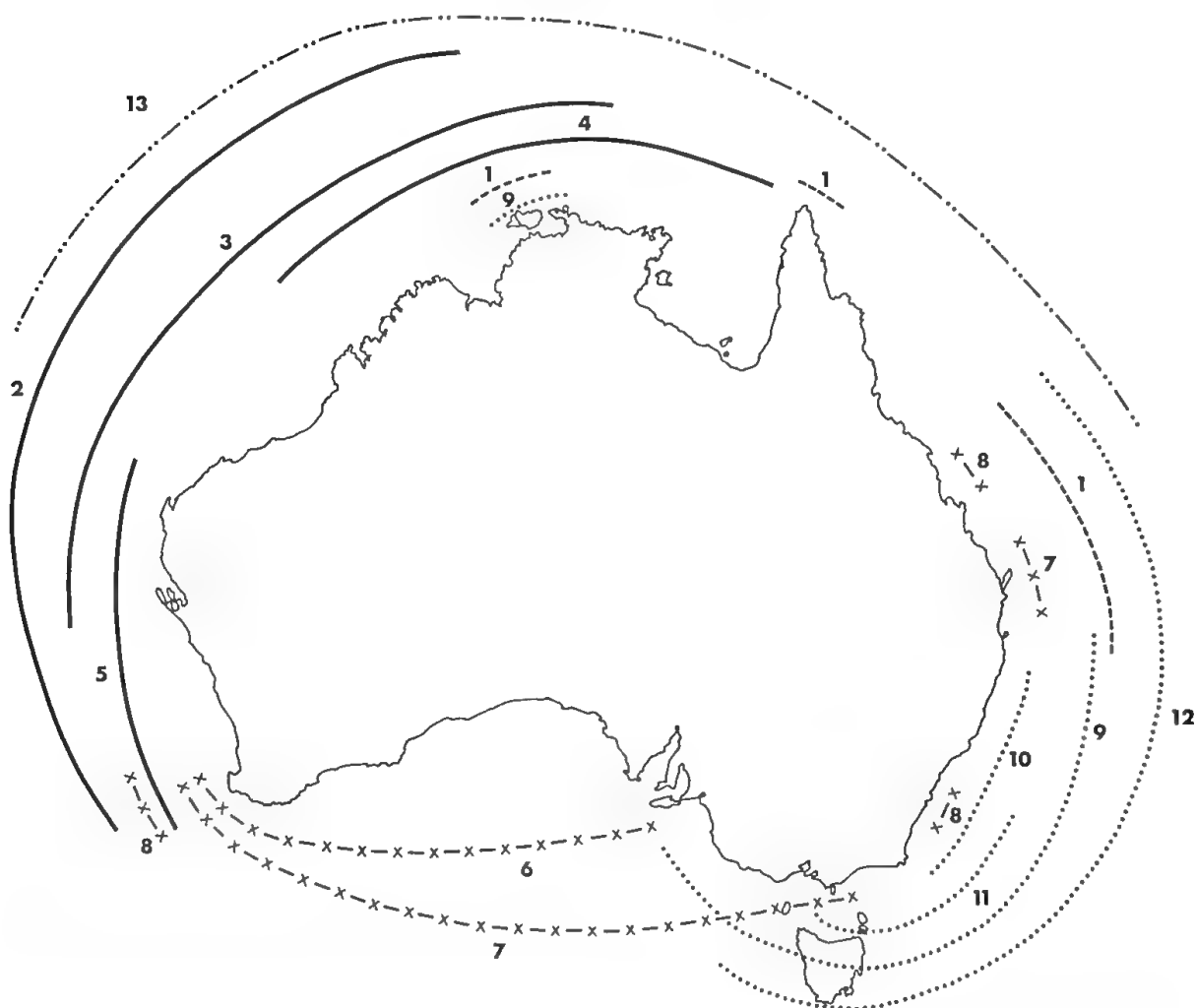


Fig. 56. Distribution patterns of selected Thalassinidea in Australia.

A NORTHERN group extending south along the EAST coast (— — — —).

1. *Callianassa haswelli*; *C. mucronata*; *Axius glyptocercus* (this species only also occurs off Cape York and Darwin).

A NORTHERN group extending south along the WEST coast (———).

2. *Axiopsis brocki*.
3. *Scytoleptus serripes*; *Upogebia giralia*.
4. *Upogebia darwinii*.
5. *Upogebia hexaceras* (occurs on west coast only).

A SOUTHERN group extending east (x — x — x).

6. *Upogebia bowerbankii*; *U. tractabilis*.
7. *Callianassa ceramica*; *Axius waroona*; *Axius plectrorhynchus* (this only also occurs in SEQld) and possibly

8. *Upogebia australiensis* with a disjunct distribution.

An EASTERN group distributed mainly along the southeastern and eastern south coasts (.....).

9. *Axiopsis australiensis*; *Callianassa arenosa*; *C. aequimana*; *Laomedia healyi*; *Upogebia simsoni* (this species only also occurs off Darwin).
10. *Axiopsis appendiculis*; *Upogebia spinifrons*.
11. *Callianassa limosa*; *Upogebia dromana*.

12. *Callianassa australiensis*.

A NORTHERN species extending south along both west and east coasts (—..—..—..).

13. *Thalassinia squamifera*.

distribution extending from some part of northeastern Australia south along the east coast to southwestern areas.

As to relationships with areas outside Australia a high degree of restriction again appears. Only 12 of the 40 species (30%) are known from outside Australia and six of those occur only in Indonesia. The affinities of the other six species are principally with the western Indian Ocean (four species). One species occurs in the Philippines and one in the Pacific (table 2). All these species are found in northern Australia.

No genus or family is confined to Australia.

Existing knowledge of the thalassinidean fauna appears to be weakest so far as coral reef, offshore and the northwestern Australian species are concerned.

It must be conceded that Australia's thalassinidean fauna as now known is rich. While it might at first appear that the faunas of other areas comprise a smaller number of species, this is not correct. It is clear that where research has recently been conducted many more species have been discovered. Areas such as the northeastern Atlantic and western Atlantic contain 53 and 49 species respectively. There are approximately 15 species in the Mediterranean (L.B. Holthuis, pers. comm.). As for the Indo-Pacific, 19 species are known from South Africa (B. Kensley, pers. comm.), and at least 44 species are known from Madagascar (M. de Saint Laurent, pers. comm.). Twenty species are known from the Red Sea (L.B. Holthuis, pers. comm.) and about 40 species are known from Japan (K. Sakai, pers. comm.). In general, however, our knowledge of the thalassinidean fauna is still so weak that really meaningful conclusions about the relationships of the Australian fauna with that of the Indo-West Pacific area as a whole or of the Indo-West Pacific fauna with the East Pacific or Atlantic cannot be drawn at this time. For instance, so far as the presently known species are concerned the principal relationships of the Australian fauna are with Indonesia; there are no species in common with New Zealand.

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Table 1
SUMMARY DATA

Family	Genus	Previous Australian Records	Number of Species		
			New Australian Records	New Species	Total
Axiidae	Axiopsis	1	2	2	5
	Axius	3		1	4
	Scytoleptus		1		1
Callianassidae	Callianassa	5	3	5	13
	Ctenocheles	1			1
	Gourretia			1	1
Callianideidae	Callianidea			1	1
Laomediidae	Laomedia	2			2
Thalassinidae	Thalassina	1			1
Upogebiidae	Upogebia	9		2	11
TOTALS	10 genera	22	6	12	40

Table 2

GEOGRAPHIC DISTRIBUTION OF AUSTRALIAN THALASSINIDEA

Family	Genus	Species total	Species restricted to Aust.	Species occurring outside Australia						
				Indonesia	Philippines	China Sea	W. Pacific Islands	E. Africa	Red Sea, Iranian Gulf	India
Axiidae	Axiopsis	5	3	2						
	Axius	4	2	2				1		
	Scytoleptus	1		1				1		
Callianassidae	Callianassa	13	10	3						
	Ctenocheles	1	1							
	Gourretia	1	1							
Callianideidae	Callianidea	1	1							
Laomediidae	Laomedia	2	2*							
Thalassinidae	Thalassina	1		1	1					
Upogebiidae	Upogebia	11	8	3	1	1	1		2	1
TOTALS	10 genera	40	28	12	2	1	1	2	2	1

**Laomedia healyi*. Recent work shows that this species probably occurs in SE Asia (K. Sakai, personal communication).

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EREMIASCINCUS, A NEW GENERIC NAME FOR SOME AUSTRALIAN SAND SWIMMING SKINKS (*LACERTILIA*: SCINCIDAE)

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A PHYLOGENETIC SUBDIVISION OF AUSTRALIAN SKINKS

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EREMIASCINCUS, A NEW GENERIC NAME FOR SOME AUSTRALIAN SAND SWIMMING SKINKS (LACERTILIA: SCINCIDAE)

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INTRODUCTION

Work on the systematics of any group of organisms above the species level has generally focused on the genus. Historically, this has been due in large part to the imperative of binomial nomenclature, i.e., every species must be placed in a genus, and, more recently, it has been due to the realization that the genus is an extremely useful biological concept when viewed as a monophyletic group of species showing strong morphological and ecological cohesiveness. A sound systematics at the generic level thus has both great practical and theoretical importance in the study of any group.

G. A. Boulenger (1887) established the foundations for the modern study of the systematics of scincid lizards in the third volume of his *Catalogue of Lizards*. In this work, Boulenger endeavoured to place all the known scincid species into rigorously diagnosed, monophyletic genera. To his apparent frustration, however, Boulenger was left at the end of his study with a large and diverse group of species that resisted further subdivision on the criteria he had applied to other genera. This group required a generic name, of course, and the name available was the now famous, or infamous, *Lygosoma*. Boulenger was not content with stopping at the required generic name, however, for to do so would have meant stifling his views on the several lineages hidden under the one name. Instead, he gave the different subgroups of *Lygosoma* subgeneric names, a procedure that was unprecedented in his treatment of other reptile groups¹.

Much of the subsequent history of skink systematics has been the relentless chipping away at this residual group of refractory skinks, often along the lines suggested by Boulenger's subgenera (Smith 1937, Mittleman 1952, Storr 1964 and Greer 1974 and 1977). In M. A. Smith's time (1937) this group was still known as *Lygosoma* but inevitably this name was applied to one of the small groups that was separated from the core, and the core then came to be known as *Sphenomorphus* (Mittleman 1952), the name by which it is known at present.

1. One of the consequences of combining a large number of species that had previously been described under other generic names into a single genus, of course, was to create many secondary homonyms. This in turn required many replacement names. Under Article 59C of the International Code of Zoological Nomenclature these replacement names must be retained as the species are parcelled out into new and resurrected genera. However, in that Boulenger and all subsequent workers have been convinced that this genus contains several lineages that are equivalent to other genera but more difficult to diagnose, it would be appropriate for the Commission to suspend Article 59C with regard to *Lygosoma*.

It is important to note, however, that even though skink systematics is still plagued by a large and diverse refractory core, there has been a fundamental advance with regard to the composition of that core between Boulenger and M. A. Smith's time and our own. The difference is that whereas formerly the core comprised skinks from more than one basic stock, today it is largely comprised of the representatives of a single stock (Greer 1974 and in prep.). Several lineages are clearly evident in the group (Greer and Parker 1967 and 1974) and current work is focusing on these subgroups. The formal recognition of these taxa, however, is fraught with difficulties.

One of the main difficulties in subdividing *Sphenomorphus* is that, like any other residual group, it encompasses a group of species that share an inordinately large number of characters that are either primitive or difficult to interpret in terms of their phylogenetic polarity. Hence the search for new characters and the interpretation of old ones are becoming increasingly esoteric.

A second problem with according formal taxonomic recognition to the subgroups of *Sphenomorphus* is that the few clearly derived character states which are evident in the most distinctive members of the suspected lineages often grade gradually and discordantly into primitive character states in related species. Many species of the *variegatus* species group, for example, are clearly derived in having (1.) a well developed secondary palate due to the extensive medial apposition of the palatal rami of the pterygoids, (2.) no supranasal scales, and (3.) more than two supraoculars in contact with the frontal scale on each side (Greer 1974). Unfortunately, however, it is easy to arrange a structural series of obviously closely related species that link these highly derived species with species that show these characters in their most primitive states. This variation obviously makes it difficult to draw the clear morphological boundaries that characterize most other skink genera.

Given these kinds of problems, therefore, it seems likely that a rigorous systematic subdivision of *Sphenomorphus* is going to come only through a series of detailed analyses of the different lineages. This paper is, in fact, an attempt to provide such an analysis for one of these lineages.

Although it is impossible at present to diagnose *Sphenomorphus* on the basis of a suite of derived characters and a distinctive ecology, it is possible to describe the group's salient morphological and ecological characteristics as they have come to be recognised, largely by default, over the last few years.

Sphenomorphus is a member of the subfamily Lygosominae (Greer 1970), and within this group its closest relatives appear to be the following genera: *Ablepharus*, *Anomalopus*, *Ateuchosaurus*, *Ctenotus*, *Eremiascincus* (named for the first time in this paper), *Hemiergis*, *Isopachys*, *Lerista*, *Lipinia*, *Lobulia*, *Notoscincus*, *Prasinohaema*, *Saiphos*, *Scincella* and *Tropidophorus* (Greer 1977 and 1979). *Sphenomorphus* can be distinguished from all of these relatives by the following combination of characters: supranasal scales usually absent, but present in some species¹; lower eyelid generally scaly, but with a window in a few species; limbs generally pentadactyl but with a reduced number of digits in a few species; no comb-like auricular projections; dorsal scales smooth or only moderately keeled, never strongly keeled; no continuous longitudinal

1. The genus *Otosaurus* has been separated from the core group of *Sphenomorphus* on the basis of the presence of a supranasal scale and/or the upper element of a double anterior loreal (Smith 1937 and Mittleman 1952). This seems unjustifiable, however, for two reasons. First, these scales are variable both between and within species, and second, the supranasal, certainly, and the upper anterior loreal, possibly, are primitive instead of derived characters and hence unsuitable by themselves for diagnosing taxa within the group.

ridges along the posterior part of the body and tail; dorsal body pattern featuring neither alternating series of light and dark longitudinal stripes nor strongly contrasting light and dark crossbands (except in a very few species).

The group comprises approximately 125 known species and occurs from southern and eastern Asia through the Indo-Australian Archipelago to the Solomon Islands and Australia; it also probably occurs in Middle America (Greer 1974).

The group occurs in a variety of habitats, but it is generally absent from deserts. Most species are surface dwelling to fossorial; arboreal forms are exceedingly rare. Activity times vary interspecifically from diurnal to nocturnal and the mode of reproduction may be either oviparous or viviparous.

RECOGNITION OF A NEW GENUS OF SKINKS

One of the most distinctive subgroups within *Sphenomorphus* is the *richardsonii* – *fasciolatus* complex of Australia (Storr 1974). This complex has a morphology and ecology that is virtually unique in *Sphenomorphus* and hence in my view deserves separate generic recognition. I therefore propose to erect a new genus for this complex, called:

Eremiascincus New Genus

TYPE SPECIES: *Hinulia richardsonii* Gray 1845. Catalogue of the Specimens of Lizards in the Collection of the British Museum, p.271.

DIAGNOSIS: *Eremiascincus* differs from *Sphenomorphus* in possessing the following combination of morphological traits: (1.) a series of low rounded dorsal ridges extending from the body, where they may occasionally be reduced or absent, onto the tail, and (2.) a pale yellow or off-white to medium brown ground colour with dark brown crossbands on



Fig. 1. *Eremiascincus richardsonii* (A.M. 54808) from the vicinity of Caranbirini Waterhole, McArthur River area, Northern Territory. SVL of specimen = 100 mm. Photo: H. G. Cogger.

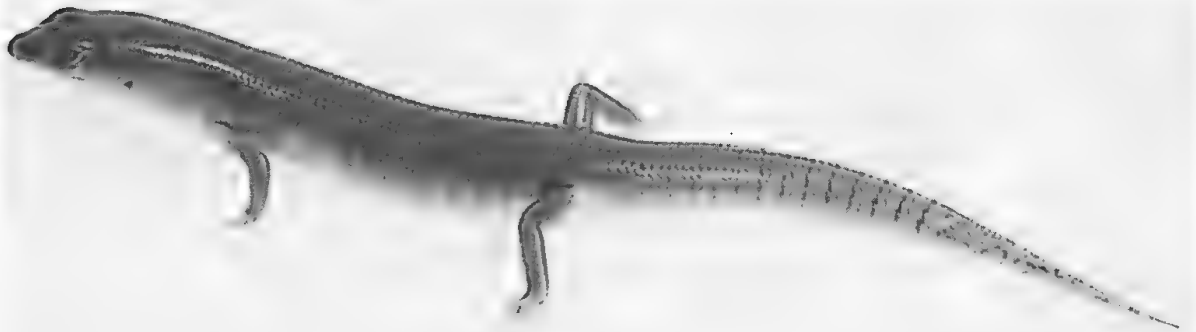


Fig. 2. *Eremiascincus fasciolatus* from approximately 105 miles N. of Carnarvon, Western Australia. Photo: H. G. Cogger.

the body and tail, although the bands may be restricted to the tail or absent altogether in some populations (Figures 1-2).

To my knowledge only *Sphenomorphus gracilipes* of southwestern Australia has dorsal ridges similar to *Eremiascincus* but these are only weakly developed when expressed at all. This species also differs significantly from *Eremiascincus* in body size, limb proportions, colour and habitat (see below).

Species in the *fasciatus* species group of *Sphenomorphus* (Greer and Parker 1967 and 1974) often have a crossbanded pattern, but rarely is it as strongly developed as in the banded populations of *Eremiascincus*, and to my knowledge no species of *Sphenomorphus* ever has a uniformly pale colour pattern similar to those populations of *Eremiascincus* that lack crossbands.

Eremiascincus also differs ecologically from all other *Sphenomorphus* in being the only members of this group to have invaded a desert environment.

ETYMOLOGY. The name *Eremiascincus* is derived from the Greek word for desert (eremias) and the Latin word for lizard (scincus). The name should emphasize the unique habitat that the genus occupies, at least in part, *vis-a-vis* its relatives. It may also call to mind the parallel between these lygosomine skinks and the scincine skinks of the genera *Scincus* and *Scincopus* of North Africa and southwest Asia which they resemble somewhat in certain aspects of colour pattern, habitat and behaviour.

SPECIES INCLUDED. Storr (1967 and 1974) has recently revised the group and recognised two species: *richardsonii* Gray 1845 and *fasciolatus* Günther 1867. The two species occur widely in the arid and semi-arid areas of Australia (Figure 4), and over their

entire range they are distinguished from each other primarily on the basis of the number and pattern of the caudal bands, and to a lesser extent by the number and pattern of the dorsal bands and by the relative length of the tail (Table 1). There is broad overlap in the last two characters, however, and it would not be surprising to find overlap in the first character as the number of specimens with complete tails increases¹.

In certain areas such as "in the centre of the continent, the species approach each other in so many characters that we can only conclude that gene flow has not long ceased between them" (Storr 1974:70). In other areas, however, notably in extensive sandy habitats, such as in the Pilbara of northwestern Western Australia (Storr 1967 and 1974) and the salt lake — sand dune country of northeastern South Australia (pers. obs.), *fasciolatus* forms distinctive "ecotypes" (Storr's term) that are sharply distinguished from neighbouring populations (which are generally identifiable as *richardsonii*) by both the loss of the dark dorsal bands on the body (and on the tail in the Lake Eyre "ghost skink") and a depressed snout. In addition, there is a good deal of as yet only poorly understood variation in other important characters, e.g., the number of supralabials, the number of infralabials contacted by the postmental, the number and length of the scale rows covering the fourth toe, the length of the exposed portion of the postorbital bone in the supratemporal arch and the degree of development of the ectopterygoid process (see below). These problems raise the possibility that despite Storr's monumental efforts with the species systematics of this group more remains to be done.

DESCRIPTION: The skinks of this genus are of medium size (maximum snout-vent length = 113 mm) with well developed pentadactyl limbs and a tail that is 1.1 — 1.7 times the snout-vent length.

In terms of the external characters that are often of systematic importance in other lygosomines, the genus may be characterized as follows: supranasal scales lacking, prefrontal scales large and either meeting medially or not; four supraocular scales, first two or three in contact with frontal; frontoparietal and interparietal scales distinct; parietal scales meet behind interparietal; enlarged nuchal scales 0-4 on each side; anteriormost nuchal separated from upper secondary temporal along posterolateral edge of parietal by one or more scales; lower eyelid scaly; iris virtually as dark as pupil; postmental in contact with either one or two infralabials on each side; external ear opening moderate in size and without enlarged lobules (Storr 1967 and 1974 and personal observation).

All mid-dorsal body scales similar in size or scales of paravertebral rows only slightly wider than those in more lateral rows; medial pair of preanal scales moderately enlarged; dorsal surface of fourth digit covered by two or more longitudinal rows of scales for at least the length of the basal phalange.

The osteological characters in the skull that are potentially important for systematic purposes are as follows: total number of premaxillary teeth generally nine but less frequently eight (Table 2); frontal forms broad surface suture with maxilla; lacrimal present; postorbital present, varying in size from moderate to long, in which case it reaches the supratemporal fenestra, but often only exposed laterally for a short distance in the supratemporal arch (Figure 3 and Table 2); palatal rami of pterygoids expanded anteriorly but generally not meeting medially (Fig 3); pterygoid teeth absent; process from ectopterygoid extending anteriorly along anterolateral edge of palatal ramus varying from nonexistent to strong, in which case it completely excludes the palatal ramus from a position on the infraorbital vacuity (Figure 3 and Table 2); Meckel's groove open; angular completely distinct.

1. Specimens with complete tails comprise only about 24 percent of the 190 specimens in the Australian Museum, National Museum of Victoria and the South Australia Museum (pers. obs.)

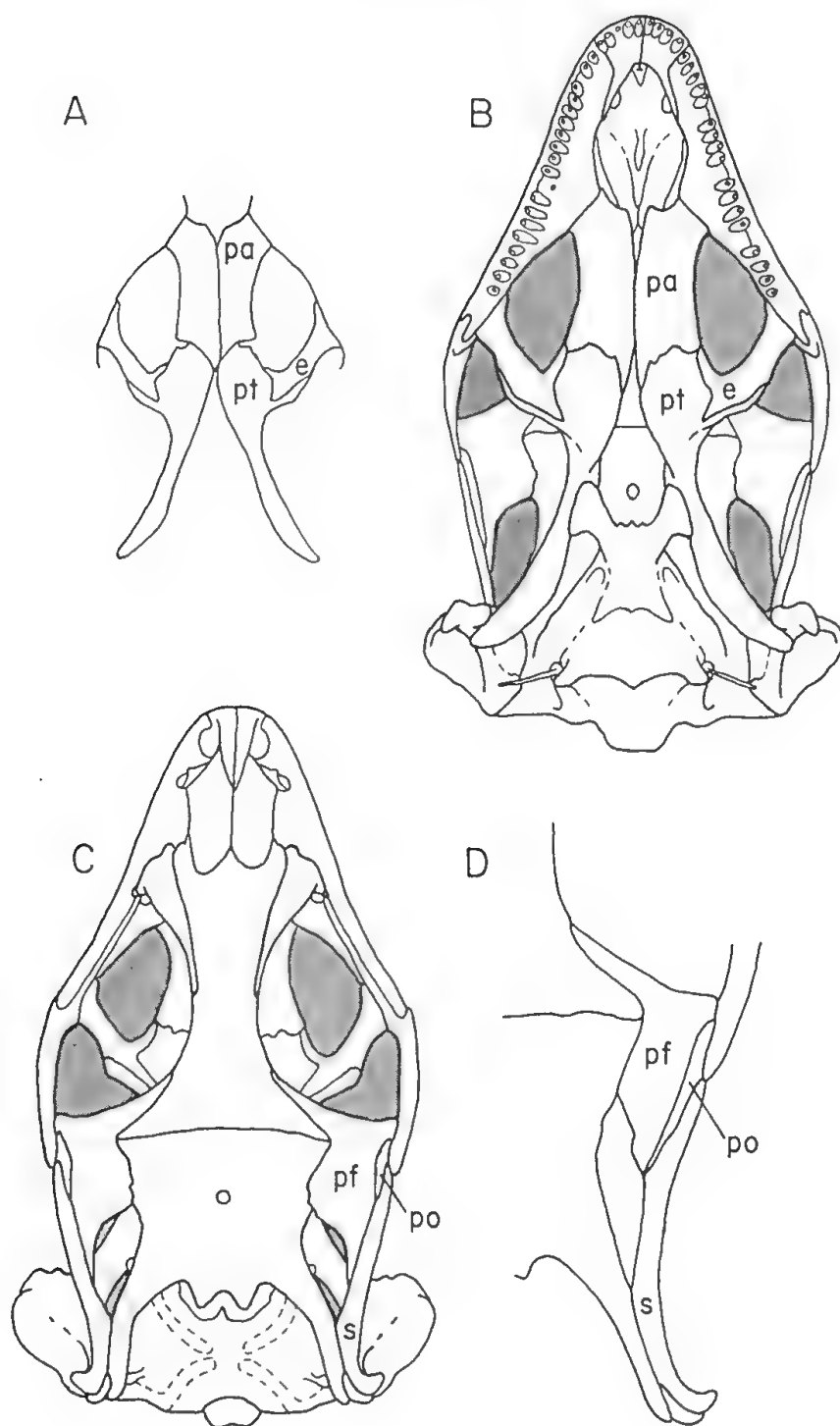


Fig. 3. Dorsal and ventral views of the skull of *Eremiascincus fasciolatus*. Whole skull (B and C) of W.A.M. 24144 and a detail of the palate of A.M. 57093 (A) and of the supratemporal arch of A.M. 57269 (D; partially reconstructed). Note the variation in the degree of development of the ectopterygoid process in the palate (A and B) and in the length of the surface exposure of the postorbital in the supratemporal arch (C and D). The length of the whole skull is 17 mm. Abbreviations: e — ectopterygoid; pa — palatine; pf — postfrontal; po — postorbital; pt — pterygoid, and s — squamosal.

It may be noted that much of the morphological and osteological variation described above would be indicative of species differences in many other skink groups including *Sphenomorphus*. To the extent that I have been able to apply current criteria for species identification in *Eremiascincus*, however, none of the variable characters serve to distinguish the two species in any absolute sense. The degree of development of the ectopterygoid process, however, may be partially diagnostic; in all specimens of *richardsonii* examined for the character, the process extended all the way to the palatine to completely exclude the palatal ramus from a position on the infraorbital vacuity (a condition indicated by the number 1 in Table 2; Figure 3B) while in most *fasciolatus* the ectopterygoid extended only part way to the palatine (indicated by a fraction in Table 2; Figure 3A).

DISTRIBUTION: *Eremiascincus* occurs throughout most of the arid and semi-arid interior of Australia (Figure 4). It is generally absent from most of the more mesic fringe along the north, south and east coasts of the continent, although it does apparently come onto the coastal plain in certain parts of southeastern Queensland, e.g., Rockhampton (Günther 1867), Port Curtis (A.M. 6382-6384, Q. M. 1837) and Ipswich (Q.M. 25430-25433).

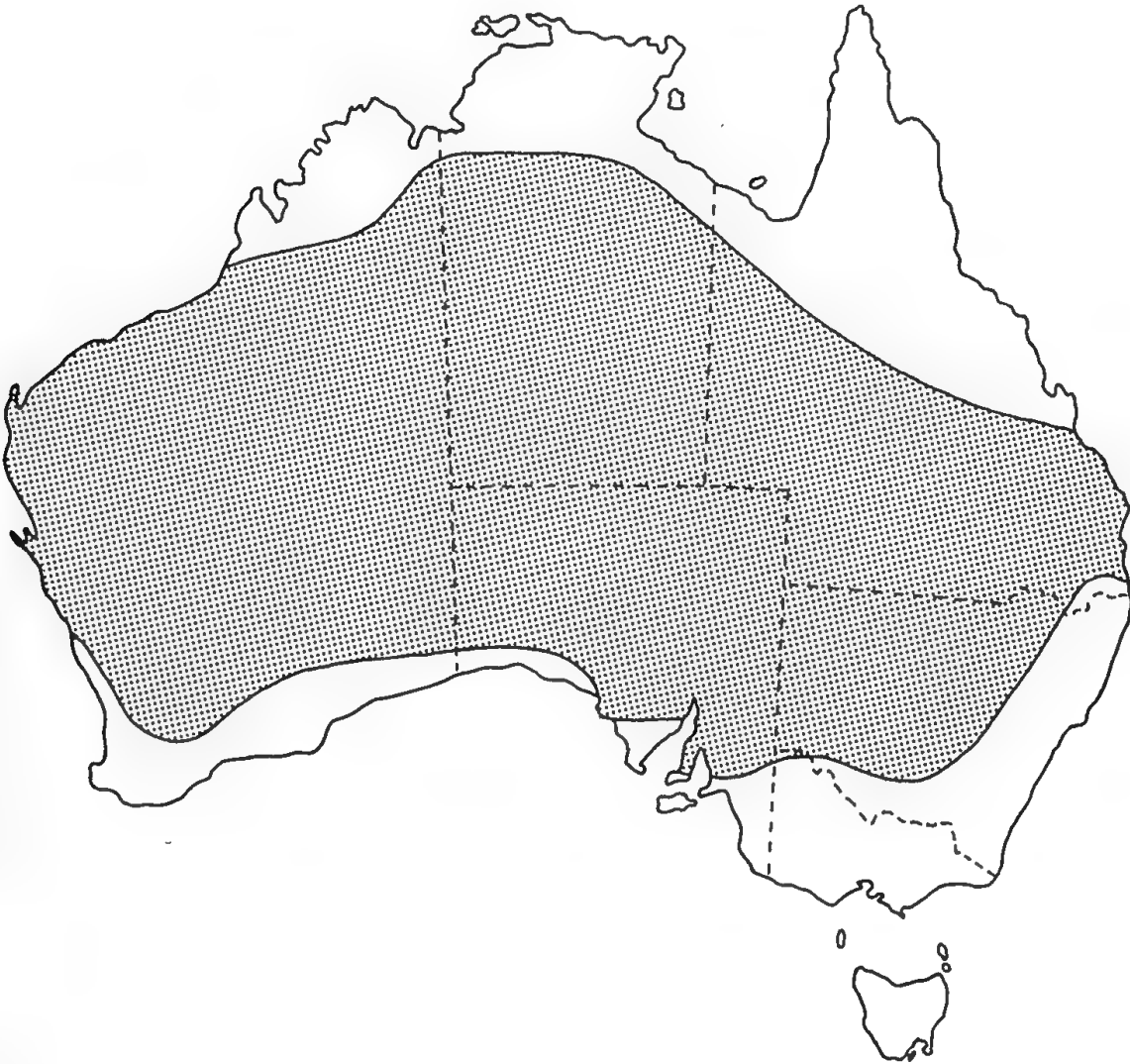


Fig. 4. The distribution of *Eremiascincus*.

As far as I have been able to determine, there are no specimens from north of a line between Bedourie and Rockhampton in Queensland, although Mr Peter Rankin (pers. comm.) reports having seen an individual (species uncertain) approximately 10 miles S.E. of Cloncurry. On the basis of both this sight record and the taxon's wide distribution elsewhere, I have drawn the distribution to include northcentral Queensland, but clearly an effort should be made to obtain specimens in this area before this part of the distribution can be accepted with confidence.

HABITAT: In his original paper Storr (1967) suggested that *richardsonii* and *fasciolatus* might have different habitat associations: *richardsonii* being associated with hilly or rocky country and *fasciolatus* being associated with plains and sand dunes. Unfortunately little new information seems to have been recorded on the habitat associations of *Eremiascincus*, but the information that has come to light tends to support Storr's suggestion. Storr himself received additional specimens that tended to confirm his views, e.g., three *richardsonii* from the upper courses of creeks flowing north from the Petermann Ranges and a single *fasciolatus* from a few miles further down one of these creeks "where the Armstrong loses itself among the sand dunes south of Lake Amadeus" (Storr 1974).

With regard to *richardsonii*, two ecological surveys are especially relevant to the question of habitat associations. In the first of these, Pianka (1969) studied in detail the ecological relationships of the lizards at eight different localities in southwestern Australia. The localities were chosen specifically for their different habitats, and although all the localities were well within the range of *richardsonii*, the species was encountered at only one site (Y): "a lake-bed community consisting primarily of chenopodeaceous shrubbery". The species was not encountered at any of the other localities which, notably, had been chosen to represent sandplain *Triodia* habitat and sandridge habitat.

More recently, Smith (1976) surveyed the reptiles of Barrow Island, Western Australia and noted that *richardsonii*, the only *Eremiascincus* encountered, was found only in the *Triodia* covered rocky areas that constitute about 80 percent of the island and not in the sandy areas that constitute the remaining 20 percent.

There are also some additional observations on *richardsonii* based on incidental observations of field collectors. At Brewarrina, New South Wales, for example, Mr Peter Rankin and his associates found seven specimens under isolated surface cover in a flat open area. There was no soft soil suitable for burrowing in the area and the animals retreated down unused mouse holes when uncovered. Mr Rankin also found single specimens of *richardsonii* near Blackall (A.M. 60003) and Charleville (A.M. 60002) in Queensland that were in areas of hard packed red soil. I can also personally report finding a single specimen (A.E.G. 98) that is probably identifiable as *richardsonii* (most of the tail is regenerated) under a log in the sandy bed of the Hugh River in rocky country approximately 51km west of Alice Springs. Dr Terry Houston (pers. comm.) has found *richardsonii* in the stony foothills of the Peake Denison Range west of Lake Eyre where there was no sandy terrain, only gibbers, within a kilometre of the site. He also notes, however, that most of his encounters with the species elsewhere occurred in red sand areas.

Most of the new information for *fasciolatus* comes from museum labels and collectors' field notes. One specimen in the South Australian Museum (S.A.M. 11175) was said to have been collected "in a small burrow in a sandy hummock" while a second (S.A.M. 11176) was said to have come from an area of "red soil with spinifex". Dr Houston writes that his brief encounters with *fasciolatus* were in the red sandridge country east of Lake Frome.

Mr Rankin has also collected *fasciolatus* on several occasions and has generously summarized his notes for me. He obtained one specimen (A.M. 59307) in the bottom of a well on the floodplain of the Darling River in southwestern New South Wales in an area with sand mounds scattered over an otherwise heavy alluvium. Shortly thereafter two juveniles were caught at the same locality in loose dry sand beneath tin. He was also present when another specimen (A.M. 61210) was dug out of a burrow in a very loose sand bank in a white sand area east of Menindee. Mr Rankin has also collected a single juvenile (A.M. 52066) near Tea Tree Roadhouse in the Northern Territory under a sheet of iron in an area of loose sand noted to be lacking in "stony elements". Three other specimens taken at Ellery Creek near Hermannsburg in the Northern Territory were caught under fibro on loose sandy soil; one of these specimens was buried in the loose soil under the fibro. Finally, I have taken a single specimen (A.E.G. 368) lacking body bands in a can trap along a drift fence set across a red sand dune some 62 km west of Ayers Rock by road.

The association with loose sandy soils implied by these records is not perfect, however, for Mr Rankin notes that three *fasciolatus* collected at Tanami Bore in the Northern Territory and now in the collections of the Museums and Art Galleries of the Northern Territory were under sheets of iron on a very hard stony soil that was typical of the area; it was also specifically noted that there was no loose soil anywhere in the immediate vicinity.

It thus appears that Storr's observations of generally distinct habitat associations for *richardsonii* (hard, rocky country) and *fasciolatus* (sandy areas) are borne out by the available additional observations. At the same time, however, the relatively small sample sizes and the few "exceptions", e.g., Dr Houston's experiences with *richardsonii* in red sand areas and Mr. Rankin's observations of *fasciolatus* on hard stony soil, make it clear that the observations need to be extended. It would be extremely useful, therefore, if in the future, collectors would record both the general habitat and the specific substrate for each specimen of *Eremiascincus* collected.

BEHAVIOUR. The forms of *Eremiascincus* are uniformly reported in the literature as being crepuscular (Houston 1973) or nocturnal (Worrell 1963, Pianka 1969 and Cogger 1975) in their occurrence at the surface. By day they are generally found under surface cover such as pieces of exfoliated granite, logs and roofing tin, or in burrows. With regard to this last retreat, *richardsonii* has been found in caves and deep crevices (Smith 1976), unused mouse burrows (Rankin, pers. comm.) and rabbit burrows (Houston 1973) and *fasciolatus* has been found "in a small burrow in a sandy hummock" (S.A.M. 11175), in an *Egernia kintorei* warren (S.A.M. 11176) and in rabbit burrows (Houston, pers. comm.). One of the most effective methods of collecting either species, in fact, seems to be by setting can traps in the loose soil in the mouths of rabbit burrows.

Mr Rankin has kept a single *Eremiascincus fasciolatus* and three *E. richardsonii* in captivity and has made the following interesting observations which he has kindly allowed me to publish. He notes that the animals stayed hidden beneath the loose substrate by day but appeared at the surface at dusk. This appearance would, however, be limited to exposing only the top part of the head and eyes while the rest of the animal remained buried. From this position the animal would hurl itself out of the substrate and onto any prey that happened to pass close by. Dr Houston also informs me that *richardsonii* in captivity immerses itself in loose sand to escape or to rest.

Both species of *Eremiascincus* are sand swimmers (Dr H. G. Cogger, Dr T. Houston, Mr P. Rankin pers. comms. and pers. obs.). Dr Houston reports that an acquaintance of his found specimens of *fasciolatus* by following tracks on sand dunes and digging down a few inches where they ended. This same person also told Dr Houston that *fasciolatus* "threaten" each other at feeding time with rapid vibrations of the tail.

It is interesting to note that in contrast to certain other arid adapted, nocturnal skinks such as the North African scincine *Scincopus fasciatus* and certain central Australian *Egernia* which have a vertically elliptic pupil (Mertens 1972 a and b), *Eremiascincus* has a circular pupil (pers. obs.).

REPRODUCTION. The only published information of the mode of reproduction in *Eremiascincus* pertains to *fasciolatus*. Unfortunately, however, this information is replete with inaccuracies and ambiguities. Waite (1929) appears to have started the problem when he quoted in full under the heading of *Hinulia fasciolata* some observations by Lucas and Frost on a female that gave birth to four young. Lucas and Frost (1894), however, made their remarks under the heading of *Hinulia quoyii*, a well known viviparous species. It is difficult to understand how Waite made the mistake of confusing *quoyii* and *fasciolatus* as the two species have never been confused in the past, and the locality of Lucas and Frost's female — Noojee in the eastern highlands of Victoria — is far outside the range of *fasciolatus* (but well within the range of *quoyii*). Waite's account of *fasciolatus* immediately follows his account of *quoyii* so perhaps the Lucas and Frost quote was misplaced.

Worrell (1963) states that *fasciolatus* is "viviparous, producing four young". In a letter (25 Oct. 1976) replying to a request for confirmation of this observation, Mr. Worrell's assistant Mrs. L. M. Abra says that Mr. Worrell did indeed have "a specimen that gave birth", but in a letter (25 Feb. 1977) replying to a request for collecting data for this specimen, she says that it was collected in the "Cairns District". The Cairns area, however, is far outside the known range of *Eremiascincus* (Figure 4), and hence the identity of the specimen and the accuracy of Worrell's observation is in doubt.

Bustard (1970) notes that *fasciolatus* "gives birth to live young", and Rawlinson (1971) lists the species as being "viviparous". I have not been able to trace the origin of Bustard's statement, but Rawlinson (pers. comm.) attributes his information to a personal communication from the late John Mitchell of South Australia. Where Mitchell obtained his information is not known, but it is worth noting that there are no preserved *fasciolatus* in the collections of the South Australian Museum that are identified as having been born in captivity. In summary, therefore, there seems to be little reliable information in the literature on the mode of reproduction of *fasciolatus*.

In an effort to learn more about the mode of reproduction in *Eremiascincus*, I examined all of the Australian state museum collections for gravid females. This involved more than 300 specimens and out of these I found seven females gravid with either enlarged (yolking or yolked) ovarian eggs or oviducal eggs (Table 3). All specimens were identifiable as *richardsonii*. Only two females had oviducal eggs and in both, the eggs were surrounded by a distinct opaque shell. The texture of these shells implied to me that the eggs would have been laid. It would thus seem that on the basis of present information *richardsonii* is oviparous and the mode of reproduction of *fasciolatus* is unknown, although there is the possibility that it is viviparous. If *fasciolatus* were viviparous, it would be one of the clearest indications that two distinct populations exist within *Eremiascincus*. For this reason, unambiguous information on the mode of reproduction in *fasciolatus* would be a most important contribution to our knowledge of the biology of these lizards.

RELATIONSHIPS. The relationships of *Eremiascincus* within the diverse complex of skinks now recognised as *Sphenomorphus* are not entirely clear but certain trends are evident and these are discussed below.

Within the Australian Region there appear to be two major species groups within *Sphenomorphus*: the *variegatus* species group and the *fasciatus* species group (Greer and Parker 1967 and 1974). These two groups are not absolutely distinct, but there are at least

eight characters that help to distinguish them and which can be used to evaluate *Eremiascincus*' broad relationships.

1. The *variegatus* group often has supranasal scales and/or a double anterior loreal whereas the *fasciatus* group almost always lacks supranasals and double anterior loreals. *Eremiascincus* also lacks these scales.

2. The *variegatus* group often has three or more supraoculars in contact with the frontal on each side whereas the *fasciatus* group rarely has more than two (three at maximum). In *Eremiascincus* three supraoculars often contact the frontal.

3. In the *variegatus* group the scales in the paravertebral rows are generally equal in size to or only slightly larger than the scales in the more lateral rows whereas in the *fasciatus* group the scales in the paravertebral rows are often, but not always, transversely enlarged. In *Eremiascincus* the mid-dorsal scales are equal in size or the scales in the paravertebral row are only slightly enlarged.

4. The *variegatus* group only rarely shows a pattern of dorsal crossbands, but this pattern occurs albeit often subtly, in the *fasciatus* group. These patterns may be related to the modal activity times of the two groups (see item 8 below). *Eremiascincus*, of course, is noted for its distinct crossbands.

5. The *variegatus* group rarely has an ectopterygoid process, but this process occurs frequently in the *fasciatus* group. Most *Eremiascincus* show some trace of an ectopterygoid process (Figure 3 and Table 2).

6. The palatal rami of the pterygoids are often widely separated in the *variegatus* groups, especially in the more primitive representatives, whereas the palatal rami are usually not separated to any great extent in the *fasciatus* group. In the more advanced members of the *variegatus* group and in most of the *fasciatus* group the palatal rami meet or are closely apposed along their extensive medial edges. In *Eremiascincus* the palatal rami are moderately separate (Figure 3) such that they would be judged intermediate in the *variegatus* group and rather widely separated in the *fasciatus* group.

7. The postorbital bone is always short and never reaches the supratemporal fenestra in the *variegatus* group whereas the postorbital is generally long and thin and reaches the supratemporal in the *fasciatus* group. The postorbital varies from medium to long in *Eremiascincus* and in some specimens reaches the supratemporal fenestra (Figure 3 and Table 2).

8. Most representatives of the *variegatus* group are active on the surface by day whereas most members of the *fasciatus* group are cryptozoic by day and only active on the surface, if at all, after dark. *Eremiascincus*, of course, is cryptozoic by day, only appearing at the surface after dusk (see Behaviour section above).

With regard to the relationships of *Eremiascincus* with either the *variegatus* group or the *fasciatus* group, character six is somewhat equivocal, characters two and three seem to tilt the decision toward the *variegatus* group, while characters, one, four, five, seven and eight, seem to support a relationship with the *fasciatus* group. On the basis of sheer numerical scores, therefore, *Eremiascincus* seems closest to the *fasciatus* group. Perhaps

even more important, however, is the fact that characters four, seven and eight probably offer the clearest basis for separating the two species groups and in all three characters *Eremiascincus* is closest to the *fasciatus* group. This relationship also receives some support from distributional information in that the *variegatus* group is not certainly represented in the Australian fauna (the *quoyi-tympanum* complex and an undescribed species from eastcentral Queensland may be representatives) whereas the *fasciatus* group is clearly represented by a large number of species.

Having tentatively identified *Eremiascincus* as a probable close relative of the *fasciatus* group of *Sphenomorphus*, it may be useful to discuss those species within this group that are similar to *Eremiascincus*.

To my knowledge *Eremiascincus* shares the diagnostic longitudinal dorsal ridges only with *Sphenomorphus gracilipes* of the extreme southwestern corner of Western Australia. It seems likely, however, that this similarity is convergent, for in *gracilipes* the ridges are only weakly developed at best and in body size and limb proportions, dorsal and ventral coloration, and habitat associations, the two taxa are quite distinct. *Eremiascincus* has a robust body with well developed limbs, generally strongly contrasting dark crossbands on relatively light ground colour and an off-white venter, and generally xeric habitat requirements, whereas *gracilipes* has an attenuate body with greatly reduced limbs, a generally uniformly dark dorsum and yellow venter, and very mesic habitat requirements.

Eremiascincus shares its highly contrasting dorsal banding pattern with the poorly known *Sphenomorphus jeudei* (Boulenger's 1914 replacement name for Lidth de Jeude's 1897 *tigrinum*) from northeastern New Guinea. This species differs from *Eremiascincus*, however, in lacking dorsal ridges (at least there is no mention of them in the type description) and, to judge from its general distribution, in inhabiting a very mesic environment. It seems likely, therefore, that *Eremiascincus* and *Sphenomorphus jeudei* have evolved strongly contrasting crossbanded patterns independently.

Apart from these species, there are two other species of *Sphenomorphus* that bear a certain similarity to *Eremiascincus* which may be indicative of close relationship. These are *Sphenomorphus isolepis*, especially as represented by the large-bodied population in the Northern Territory,¹ and *S. nigricaudis* from southern New Guinea, the islands of Torres Strait and Cape York Peninsula (see Figure 5 for the distribution of these two species in Australia). Neither of these species has the diagnostic dorsal ridges of *Eremiascincus* but both are similar to *Eremiascincus* in body size and limb proportions. Neither species has the striking crossbands of *Eremiascincus*, but both species have a dorsal pattern of dark spots that may be oriented transversely. These crossbands are especially prominent in *nigricaudis* but can also be discerned in some *isolepis* as well.

Sphenomorphus isolepis also shares some of the characters seen in *Eremiascincus* that are more characteristic of the *variegatus* species group than the *fasciatus* species group, e.g., often three supraoculars in contact with the frontal, subequally sized dorsal scales

1. My concept of *isolepis* excludes *douglasi* (cf. Storr 1967 and 1972). The two species can be readily distinguished on the basis of the number of the supralabial scale that falls directly below the centre of the eye and colour pattern: *isolepis* generally has the fifth supralabial below the centre of the eye and a colour pattern of distinct spots distributed more or less uniformly over the dorsum whereas *douglasi* generally has the fourth supralabial below the centre of the eye and a distinct dark dorsolateral stripe on a generally unspotted or at least much less heavily spotted dorsum. Both species occur syntopically in certain localities in the Northern Territory (Dr H. G. Cogger pers. comm.), and if *brongersmai* is conspecific with *douglasi*, as I believe it is, then *douglasi* and *isolepis* also occur together in the northern Kimberleys (Storr 1972).

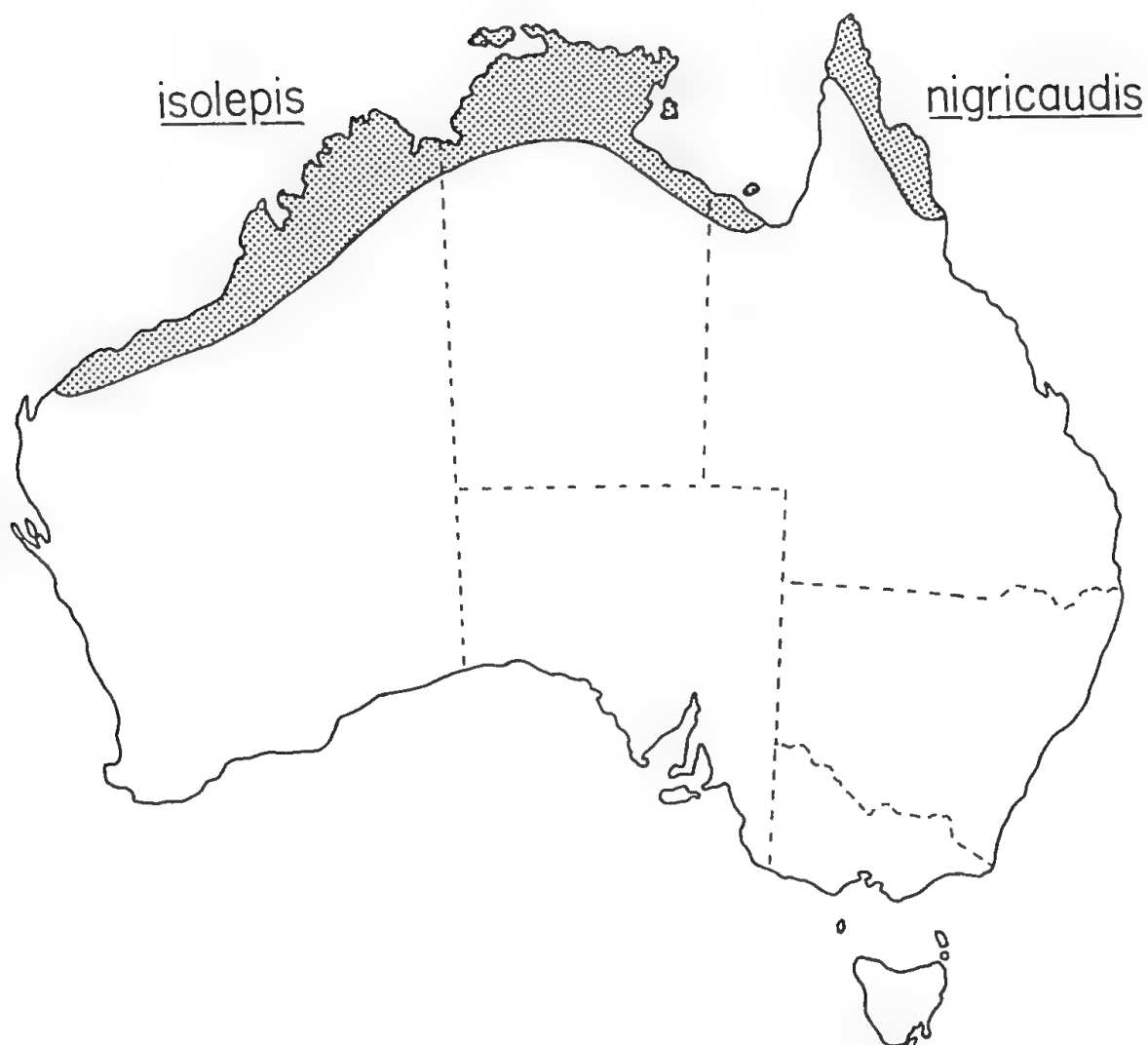


Fig. 5. The distribution in Australia of the two members of the *fasciatus* species group of *Sphenomorphus* that appear to be the closest living relatives of *Eremiascincus*.

and slightly separated palatal rami (although perhaps not as widely separated as in *Eremiascincus*). *S. isolepis* is nevertheless, a typical representative of the *fasciatus* group on other characters: it lacks supranasals, has both an ectopterygoid process and a long thin postorbital (pers. obs), is cryptozoic by day but active on the surface at night (Cogger 1975), and like most other members of the *fasciatus* group it is a litter swimmer.

If *Sphenomorphus isolepis* and *S. nigricaudis* are the closest living relatives of *Eremiascincus*, they are probably most reasonably regarded as conservative derivatives of the lineage that gave rise to *Eremiascincus*. Structurally they are more primitive than *Eremiascincus* in lacking this taxon's unusual dorsal ridging and colour pattern, and ecologically they occur in seasonally dry habitats (savanna to monsoon forest) that may have preadapted their lineage for an invasion of the arid interior.

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I also appreciate some very interesting discussions about *Eremiascincus* with Dr H. G. Cogger, Mr H. F. W. Ehmann, the late Mr P. R. Rankin, and Dr G. M. Storr, all of whom know *Eremiascincus* in the field far better than I. These colleagues also provided helpful critical reviews of the manuscript. Dr T. Houston very graciously summarized his knowledge of *Eremiascincus* for me in a long letter (13 April 1977), and I have included many of his observations nearly verbatim.

Dr H. G. Cogger generously provided the photographs for Figures 1-2.

My wife Phlyp drew Figure 3 and read manuscript for me. She also had a hand in catching the few *Eremiascincus* we've seen in the field.

Finally, I would like to gratefully acknowledge the research fellowship (Fulbright) from the Australian-American Educational Foundation, Canberra, A.C.T. which has made this work possible.

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Note Added in Press

After this paper went to press, I received from Mr Gary Stephenson a single adult *Eremiascincus richardsonii* from 20 km east of Three Ways Roadhouse, N.T. This animal was kept in the laboratory for three months and the following observations made. At first the animal spent most of its time buried in the loose red soil that comprised the substrate of its cage, and it would only appear on the surface during mid to late afternoon. Later, however, it switched its retreat to a newly introduced piece of surface cover and would appear at various times of day to bask with eyes closed and limbs stretched back along its body under an incandescent light placed directly above its cage.

The animal was a voracious predator, attacking and devouring the hatchling geckos, skinks and baby mice that were introduced into its cage. When prey was offered, the *Eremiascincus* would generally remain motionless except for a slow twitching of the end of the tail and then suddenly attack, often going directly for the head of larger lizards. Upon grasping its prey, the animal would often rapidly rotate the entire body and tail around its long axis, presumably to aid in subduing the prey. Pieces of banana and grape were also offered but only the former was eaten. The animal drank readily.

TABLE 1. Summary of the characters used by Storr (1974) to distinguish *richardsonii* and *fasciolatus*.

Character	<i>richardsonii</i>	<i>fasciolatus</i>
Dark crossbands on tail	19-32; wider, less regular (often oblique and branching)	35-40; narrower, and more regular (usually one scale wide, perfectly transverse, and separated by interspace of two scales)
Dark crossbands on body	8-14; wider (up to as wide as interspaces), sharper-edged and more strongly contrasting with pale ground colour.	10-19; much narrower than interspaces, often breaking mid-dorsally and not much darker than ground colour.
Tail length	131-171% of SVL	114-142% of SVL

TABLE 2. Summary of the total number of premaxillary teeth, the degree of exposure of the postorbital bone in the supratemporal arch and the degree of development of the ectopterygoid process in specimens of *Eremiascincus* (see text for details).

Specimen	Locality	<i>fasciolatus</i>	<i>richardsonii</i>	Number of premaxillary teeth	Degree of exposure of postorbital bone in supratemporal arch	Degree of development of ectopterygoid process
A.M. 57269	Rockhampton, Qld.			9	Long	1
A.M. 5317	Upper Burnett River, Qld.			?	Long	?
S.A.M. 9929	Milparinka, N.S.W.			9	?	1/2
A.M. 61210	ca. 9.5 mi. E. Menindee, N.S.W.			9	?	1/2
A.M. 9544	Broken Hill District, N.S.W.			9	Short	0
A.M. 35245	8 mi. N.W. Birdsville, Qld.			9	?	2/5-3/5
A.M. 57093	Cluny Sta., Bedourie, Qld.			9	Short	2/5
W.A.M. 24144	4 mi. S. Larrimah, N.T.			9	Short	1
M.C.Z. 35442	Hermannsburg, N.T.			9	Short	1/2
N.M.V. 467	Illamurta, James Range, N.T.			8	?	1/3
Q.M. 11984	Waratah, Cunnamulla, Qld.			?	?	?
A.M. 42151	Sturt Nat'l. Park, N.S.W.			9	Short	1
S.A.M. 15465	Silverton, N.S.W.			9	?	1
A.M. 2117	Central Australia			8	Long	1
A.M. 7141	Mt. Lyndhurst, S.A.			8	Short	1
N.M.V. 41999	3 mi. S. main Ord River dam site, W.A.			9	?	1
W.A.M. 17894	Woodstock, W.A.			9	Medium	1
Q.M. 1838	Western Australia			?	?	0
A.M. 2115	Central Australia		Identification uncertain	9	Medium	1

TABLE 3. Summary of information on body size, clutch size, locality, and date of collection for *Eremiascincus richardsonii* gravid with either enlarged (yolky) ovarian eggs ("o") or oviducal eggs.

Specimen	SVL (mm)	Number of eggs on right (R) and left (L) side and total	Locality	Date
W.A.M. 40772	—	3R — 1+? = 4 + ?°	4 mi. S. Old Lissadell H.S., W.A.	4 Oct. 1971
W.A.M. 25103	116	3R — 4L = 7°	Woodstock Station, W.A.	Nov. 1959
W.A.M. 30855	95	2R — 4L = 6°	Marloo Station, W.A.	2 Feb. 1968
S.A.M. 993A	79	2R — 2L = 4°	Kingoonya, S.A.	—
S.A.M. 164A	88	ovarian eggs	Beverley, W.A.	—
S.A.M. 15067A	79	2R — 1L = 3	3 km. N.E. Arcoona H.S., S.A.	25 Nov. 1975
W.A.M. 17891	104	2R — 1L = 3	Woodstock, W.A.	Mar. 1958

A PHYLOGENETIC SUBDIVISION OF AUSTRALIAN SKINKS

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Skinks are the largest and most diverse of the five families of lizards in Australia. The most recent review of the lizard fauna, for example, recognizes 193 species (54 percent of the total; Cogger 1975), but as a result of recent work by several collectors, we now know of at least 242 species. Furthermore, new species are being discovered at a faster rate than in any other family of Australian reptiles (pers. obs.).

Quite justifiably, Australian skinks are receiving considerable attention from researchers whose interests range from cytogenetics (e.g., King 1973 a and b and Donnellan 1977) and ecology (e.g., Barwick 1965, Bustard 1970, Pengilley 1972, Pianka 1969, Robertson 1976, Smyth 1968, Smyth and Smith 1968 and Spellerberg 1972 a-d) to systematics (e.g., the many papers of Storr cited at the end of this paper) and zoogeography (e.g., Horton 1972, Pianka 1972 and Rawlinson 1974 a).

Given the numbers and diversity of Australian skinks and the interest in them, it may be useful to present a subdivision of this fauna that reflects major phylogenetic lineages. Hopefully, such a subdivision will provide a broad conceptual framework for synthesizing both old and new information about these animals.

MATERIALS AND METHODS

All the skinks in Australia, and indeed in the Australian Region, are members of the subfamily Lygosominae, the largest, most diverse and most widespread of the four subfamilies currently recognised (Greer 1970 a)¹. Several distinct groups are recognisable within lygosomines (Greer 1970 b, 1974 and 1977) and three of these occur in Australia. In this paper these groups will be called the *Egernia*, *Eugongylus* and *Sphenomorphus* groups. They can be diagnosed by the means of eight characters: two of osteology, four of squamation, one of colour and one of internal soft anatomy.

A list of the specimens examined for this paper would be very long, hence it may be more realistic to give only a general account of the material examined. The first osteological character, the total number of premaxillary teeth, has been surveyed for a large number of specimens of most Australian species (Table 1) but only a few specimens, often only one, in a variety of non-Australian species. This disparity is due to the availability of large series of Australian skinks which have been preserved with their mouths open as opposed to, generally, only single dried skulls of non-Australian species.

The other osteological character, the condition of Meckel's groove, has been surveyed in at least a single species of each genus or major species group with the exception of the following very rare taxa: *Phoboscincus* and *Tachygia*.

1. Rawlinson (1974 a) has suggested that *Egernia* and *Tiliqua* are representatives of the subfamily Scincinae (sensu Greer 1970 a), a primitive and now somewhat relictual subfamily that was almost certainly ancestral to the lygosomines. I do not believe that the evidence supports this suggestion but defer discussion of it to another paper.

The four characters of squamation have been surveyed in most of the species in the three groups due to the general availability of alcoholic specimens.

The colour character, the colour of the iris, has been examined in most of the Australian species and in at least a single specimen of the following non-Australian species: *Corucia zebrata*, *Lipinia noctua*, *Prasinohaema virens* (Kodachrome only) and *Tribolonotus schmidtii*.

The character of soft anatomy, the morphology of the everted hemipenis, has been examined in at least a single specimen of all Australian genera and in single specimens of the following non-Australian species: *Lipinia noctua* and *Tribolonotus schmidtii*. It would, of course, be most useful if workers with access to live specimens of the non-Australian taxa in the three groups outlined here would check their animals for these last two characters.

The primitive and advanced character states of each of the characters have been inferred by considering the state of the character in three different taxa: (1.) the gerrhosaurine cordylids (as represented by *Gerrhosaurus*,) the group that appears to encompass the closest living relatives of skinks (pers. obs.); (2.) *Eumeces*, the genus that seems to comprise the most generally structurally primitive species in the most primitive subfamily of skinks, i.e., the Scincinae (see the Appendix of this paper), and (3.) *Mabuya*, the genus that seems to comprise the most generally structurally primitive species among the lygosomines as determined on characters other than those used in this analysis (see the Appendix).

Most lygosomines belong to one of the three groups outlined here and hence the diagnosis and discussion of relationships of these groups will serve as an introduction to the place of these skinks in the radiation of the lygosomines as a whole. Discussions of the relationships of the remaining skinks in this radiation will be found in Greer 1967 b, 1970 b, 1976 a and 1977.

Finally, it may be mentioned that although this paper emphasizes morphology, a popular account of the ecology and behaviour of the Australian representatives of the three groups discussed here will be found in Greer 1976 b.

ANALYSIS OF CHARACTERS

(A.) *Premaxillary tooth number*. The total number of teeth on the two premaxillary bones appears to be resolvable into three modal conditions, at least in surface dwelling forms: (A) nine, (a) eight or fewer (almost invariably seven), and (a') 11 or more (generally 13) (Table 1).

The number of premaxillary teeth is significantly variable only in the *Sphenomorphus* group. The more surface dwelling members of this group, e.g., *Sphenomorphus* and *Eremiascincus*, generally have nine premaxillary teeth whereas the many burrowers in the group often have fewer, e.g., *Anomalopus* (9-5), *Hemiergis* (8) and *Lerista* (7-5). It seems likely, however, that the fewer number of premaxillary teeth in these burrowers is a reduction from the primitive number of nine. There are three reasons for believing this. First, nine is probably the primitive number of premaxillary teeth for lygosomines in general (see below). Second, in any group of skinks, burrowing habits are more likely to be derived than surface dwelling habits and hence any associated aspect of a burrower's morphology that may otherwise be difficult to interpret in phylogenetic terms (e.g., tooth

number) is more likely to be derived than primitive. And third, the burrowing genera with fewer than nine premaxillary teeth all appear, on the basis of characters whose phylogenetic polarity is not difficult to infer without recourse to secondary associations such as habitat, to be derived from *Sphenomorphus* (Greer 1967 a, 1973 and work in progress) which has a modal number of nine premaxillary teeth (Table 1).

Although burrowing habits may account for the reduced number of premaxillary teeth in the burrowing members of the *Sphenomorphus* group, they cannot account for the fewer premaxillary teeth in the numerically large, surface dwelling genus *Ctenotus* in which the modal number is seven (Table 1). On most other characters, however, *Ctenotus* appears to be allied to the *Sphenomorphus* group. Most *Ctenotus* have a slightly conical snout which appears to have been brought about by a narrowing of the premaxillary region, and this may have been responsible for the loss of two teeth.

Notoscincus, which is also in the *Sphenomorphus* group, has a modal number of 8 (range 9-7) premaxillary teeth (Table 1). I have no explanation for this apparent reduction.

Finally, it may be noted from the data given in Table 1 that premaxillary tooth number is often a useful systematic character at the specific and generic level.

Although gerrhosaurines, or at least *Gerrhosaurus*, and *Eumeces* have a total of seven premaxillary teeth, I believe that a total of nine premaxillary teeth is probably primitive for lygosomines (A) and that both a lower (a) and higher (a') number are independently derived. The reason for this is that nine seems to be the most frequent number in the lygosomines that seem generally primitive on other grounds, and it is also the number that seems to occur most frequently in different lygosomine lineages.

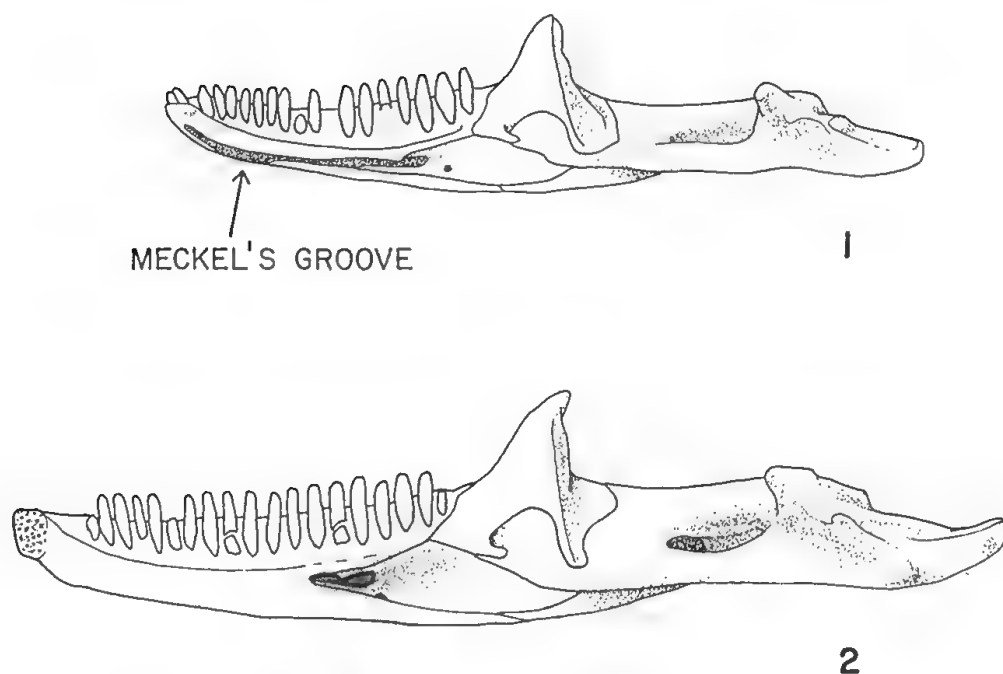
(B.) *Meckel's groove*. Meckel's groove may be either (B) open on the lower lingual side of the dentary or at the very least represented by a longitudinal suture in the overlapping dentary (Fig. 1 this paper and Fig. 32 in Greer 1974) or (b) completely obliterated by the overlapping and fusion of the dentary (Fig. 2 this paper and Fig. 33 in Greer 1974).

Most *Ctenotus* have the open condition typical of the *Sphenomorphus* group, but at least one of the small species, i.e., *schomburgki*, has the groove obliterated for all but a short distance anteriorly. *Notoscincus* appears to be the only taxon in the *Sphenomorphus* group which has the groove completely obliterated over its entire length.

In an earlier paper, I suggested that the open condition of Meckel's groove in lygosomines was perhaps secondarily derived from the closed condition (Greer 1974). My reason for this was that *Mabuya* seems remarkably primitive in a large number of characters whose phylogenetic polarity seems clear, and I was therefore willing to let this association guide my inferences in other characters. I now think, however, that this association of primitive characters cannot quite match the evidence from gerrhosaurines, *Eumeces* and the fossil record of reptiles in general (Romer 1956) that the open condition is primitive (B) and the closed condition derived (b).

(C.) *Interparietal and parietal scales*. The parietals may either be (C) completely separated by the interparietal or (c) meet behind the interparietal (Figs. 3 and 4).

There is little variation in this character within the major groups. In most members of the *Sphenomorphus* group the parietals meet behind the interparietal but in some individuals of the *Sphenomorphus quoyii* complex the parietals are completely separated by the interparietal.



Figs. 1 and 2. Lingual aspect of the lower jaw: 1, Meckel's groove open as in the *Sphenomorphus* group (*Sphenomorphus douglasi*); 2, Meckel's groove obliterated by the overlapping and fusion of the dentary as in the *Egernia* and *Eugongylus* groups (*Egernia striata*).

Although gerrhosaurines have the parietals meeting broadly behind the very small interparietal, *Eumeces* and *Mabuya* generally have the parietals separated by the interparietal (C) and for this reason, this condition is taken as primitive in lygosomines and the condition in which the parietals meet behind the interparietal is taken as derived (c).

(D.) *Scales along the posterolateral edge of the parietal scale.* Each parietal scale may be bordered along its posterolateral edge by either (D) two or more temporals and a medial nuchal which is often transversely enlarged and generally oriented obliquely to the parietal (Fig. 3 this paper and Figs. 18-21 in Greer 1974), or (d) only one temporal and a nuchal which is almost always enlarged and generally oriented flush with the parietal (Fig. 4 this paper and Figs. 22-27 in Greer 1974).

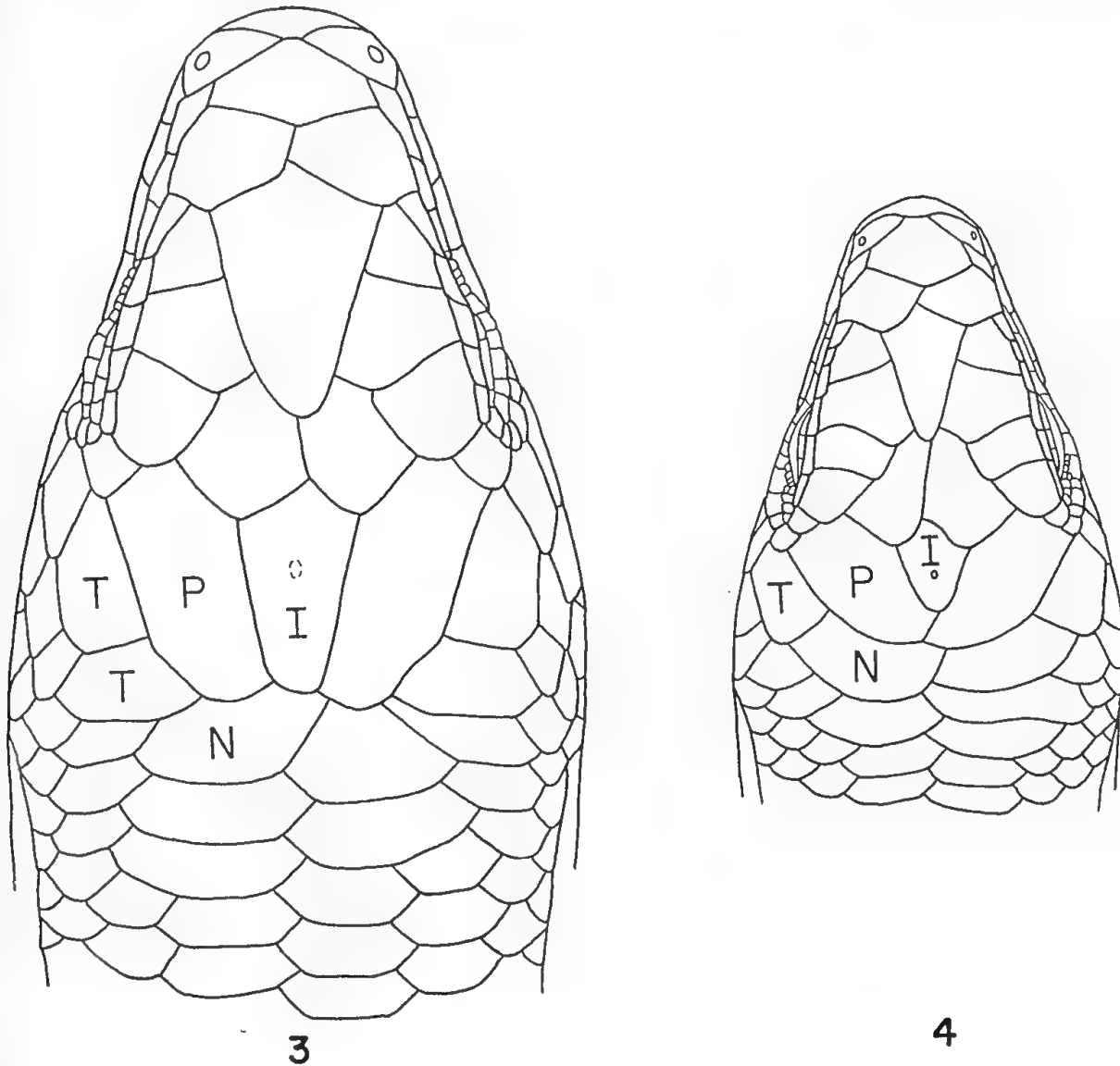
Most members of the *Sphenomorphus* group have two or more temporals and a nuchal bordering each parietal, but several species of *Lerista* and *Ctenotus* have only one temporal and a nuchal.

Some species show both states, sometimes even in the same individual. In these cases a survey of the population may be required to characterize the species accurately. I have found, however, that those species which show appreciable variation in this character are often most closely related to species characterized by state D.

The phylogenetic polarity of the two states of this character is difficult to infer. The situation in gerrhosaurines is not particularly telling in that there are numerous small temporals and nuchals bordering each parietal, but perhaps this condition is closest to

state D. *Eumeces* has only a single temporal and a nuchal (d) whereas *Mabuya* has two temporals and a nuchal (D). The evidence is thus not conclusive but in general I believe it indicates that the character state suggested by gerrhosaurines and shown by *Mabuya*, i.e., two or more temporals and a nuchal, is probably primitive (D) and the state shown by *Eumeces*, i.e., a single temporal and a nuchal, is derived (d).

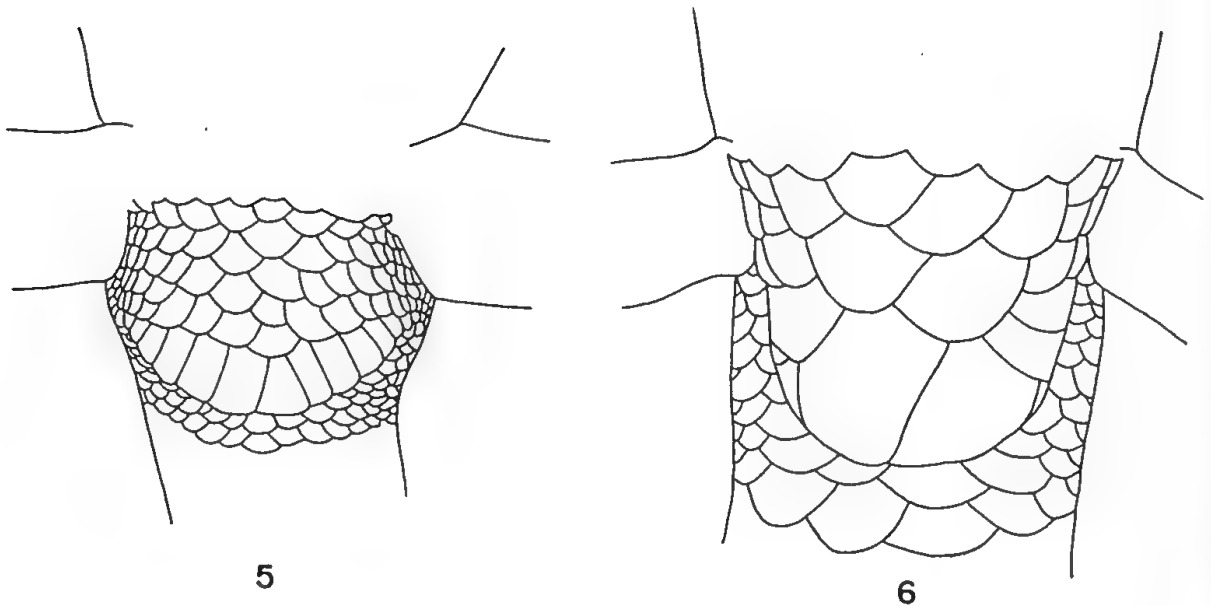
When I evaluated this character in an earlier paper (Greer 1974), I emphasized the orientation of the nuchal instead of the number of temporals, and because *Mabuya* had flush nuchals I took character state d as primitive. I now believe, however, that the number of temporals is the least equivocal and hence most important aspect of this character, and because *Mabuya* has two temporals bordering each parietal, I can now accept state D as primitive.



Figs. 3 and 4. Dorsal view of the head of two Australian skinks showing the relationship between the parietal (P) and interparietal (I) scales and the arrangement of the nuchal (N) and temporal (T) scales along the posterolateral edge of the parietal scale: 3, *Tiliqua casuarinae*; 4, *Leiopisma entrecasteauxii*.

(E.) *Medial pair of preanal scales*. The medial pair of preanal scales may be either (E) more or less equal in size to the lateral preanals (Fig. 5 this paper and Fig. 29 in Greer 1974) or (e) moderately to greatly enlarged (Fig. 6 this paper and Fig. 28 in Greer 1974).

Gerrhosaurines appear to have a few large but equal sized preanals which are perhaps most similar to state E. *Eumeces* has a very large medial pair of preanals (e) whereas *Mabuya* has a series of moderate but more or less equal sized preanals (E). As in the case of the nuchal and temporal scales (character D), I find it a bit difficult to make a decision as to the probably phylogenetic polarity of these two character states, but I am again inclined to take the condition suggested by gerrhosaurines and shown by *Mabuya*, i.e., equal sized preanals, as primitive (E) and the condition shown by *Eumeces*, i.e., a large medial pair of preanals, as derived (e).



Figs. 5 and 6. The two conditions in the size of the preanal scales in Australian skinks: 5, the subequal preanals of the *Egernia* and *Eugongylus* groups (*Leiolopisma ocellatum*) and 6, the enlarged medial pair of preanals of the *Sphenomorphus* group (*Sphenomorphus gracilipes*).

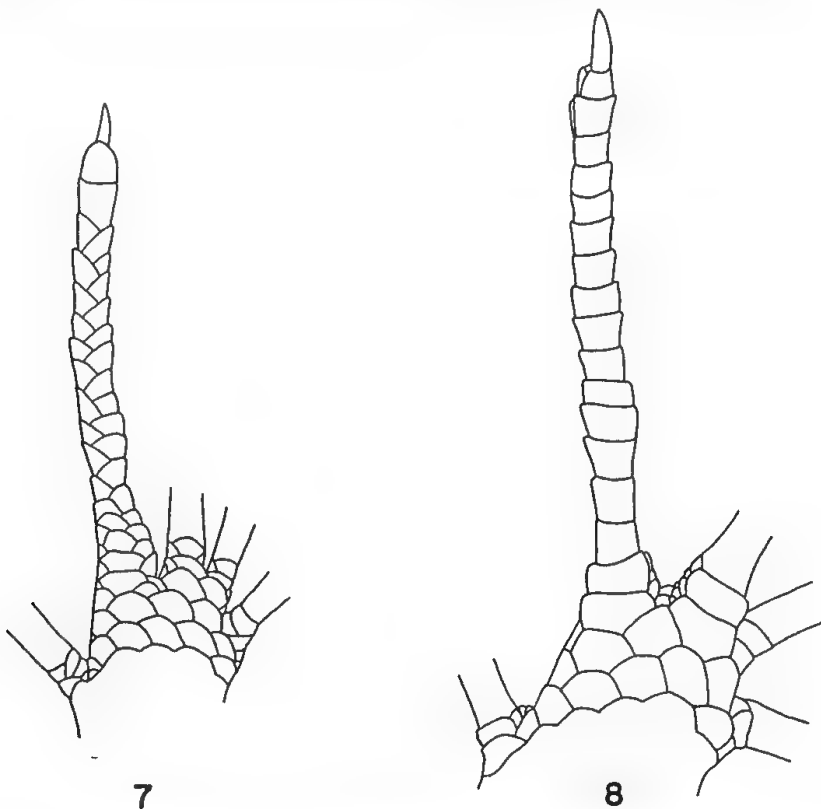
(F.) *Supradigital scales*. The scales on the dorsal surface of the fourth toe appear to be separable into two modal conditions: F.) two or more longitudinal rows of scales extending over at least the basal part of the digit but often extending much further (Fig. 7 this paper, Fig. 1b-h in Brongersma 1942 and Fig. 30 in Greer 1974) and f.) a single row of scales throughout the entire length of the digit (Fig. 8 this paper, Fig. 1 a in Brongersma 1942 and Fig. 31 in Greer 1974).

There is some variation in character state F that serves to separate the two major groups with this character. In the *Sphenomorphus* group there are generally two or more longitudinal scale rows extending over at least the basal half of the digit while in the *Egernia* group there is generally only a short second row comprising two to four scales confined to the base of the digit. Most *Tiliqua*, which are in the *Egernia* group, have but a single row of scales throughout the length of the digit.

The *Eugongylus* group generally has a single row of scales throughout the length of the digit, but in a few of the larger species, e.g., *Eugongylus* and some *Emoia*, there is a short second row of scales at the extreme base of the digit.

The genera *Lerista* and *Notoscincus* which are in the *Sphenomorphus* group are exceptional in having but a single row of scales covering the fourth toe.

Gerrhosaurines, *Eumeces* and *Mabuya* all have a multiple row of supradigital scales extending over at least the basal part of the digit; this character state is therefore taken as primitive (F) and a single row is taken as derived (f).

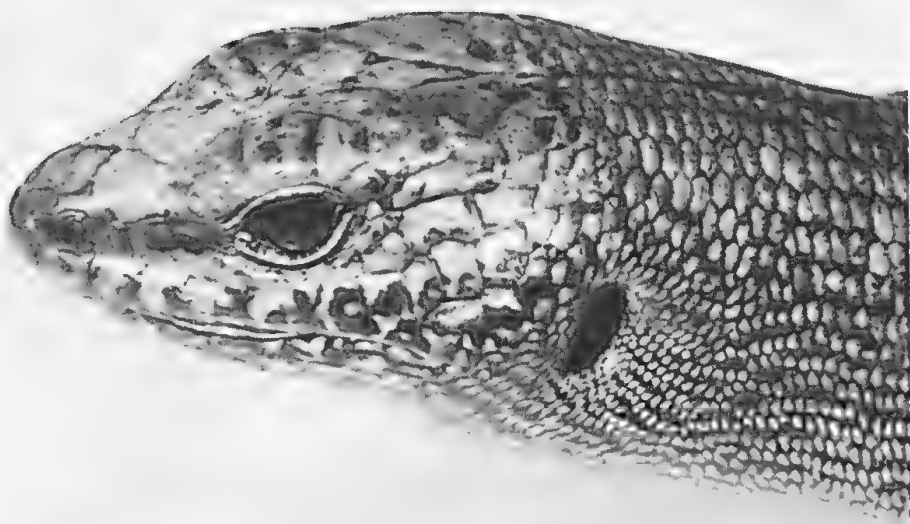


Figs. 7 and 8. The two conditions of the scales covering the dorsal surface of the fourth toe in Australian skinks: 7, the multiple rows of scales of the *Egernia* and *Sphenomorphus* groups (*Sphenomorphus gracilipes*) and 8, the single row of scales of the *Eugonylus* group (*Leiopisma entrecasteauxii*).

(G.) *Iris colour*. The iris may be either (G) distinctly paler than the black pupil in showing cream, pale green, yellow, orange or gold colour often with metallic tints and textures (Fig. 9) or (g) virtually as dark as the pupil in being very dark liver or blackish brown in colour (Fig. 10). In the first condition the iris is generally easily distinguishable from the pupil with the naked eye in good light but in the second both a hand lens and good light may be required. In either case the determination is best made on live material.



9



10

Figs. 9 and 10. The two types of iris colour in Australian skinks: 9, the iris appreciably lighter than the pupil as in the *Egernia* and *Eugongylus* groups (*Egernia frerei*) and 10, the iris virtually as dark as the pupil as in the *Sphenomorphus* group (*Sphenomorphus* new species).

In my experience iris colour can be determined in most skinks without difficulty. Some *Egernia cunninghami* and *Tiliqua rugosa* in the *Egernia* group have a dark grey iris while their relatives have a distinctly lighter iris. Some *Cryptoblepharus* in the *Eugongylus* group also have a large amount of black pigment in the iris, especially around the pupil, but close inspection will reveal light pigment in more peripheral areas. Many species in the *Eugongylus* group also may have a small diffuse-edged section of dark pigment directly behind the iris and often a smaller section in front, but the basic light colour of the iris is generally obvious in these forms. It should perhaps be noted that none of these exceptions, which are somewhat "dark eyed" forms in basically "light eyed" groups, have the iris as dark as in the basically "dark eyed" *Sphenomorphus* group.

Gerrhosaurines, *Mabuya* and most other lizards generally appear to have a light iris, whereas *Eumeces* generally appears to have a very dark iris. A light iris is therefore taken as primitive (G) and a dark iris is taken as advanced (g).

(H.) *Hemipenis*. The morphology of the fully everted hemipenis can be resolved into one of two types: H.) one with a relatively short, columnar base and a slightly bulbous or bilobed cap (Figs. 11-13), and h.) the other with a long narrow base and two equally long bifurcations (Figs. 14-15).

Although these two hemipenial types are quite distinct, it is clear that there is a good deal of important variation within each type, especially the first. This variation should be of great value in work on the relationships of both species and genera.

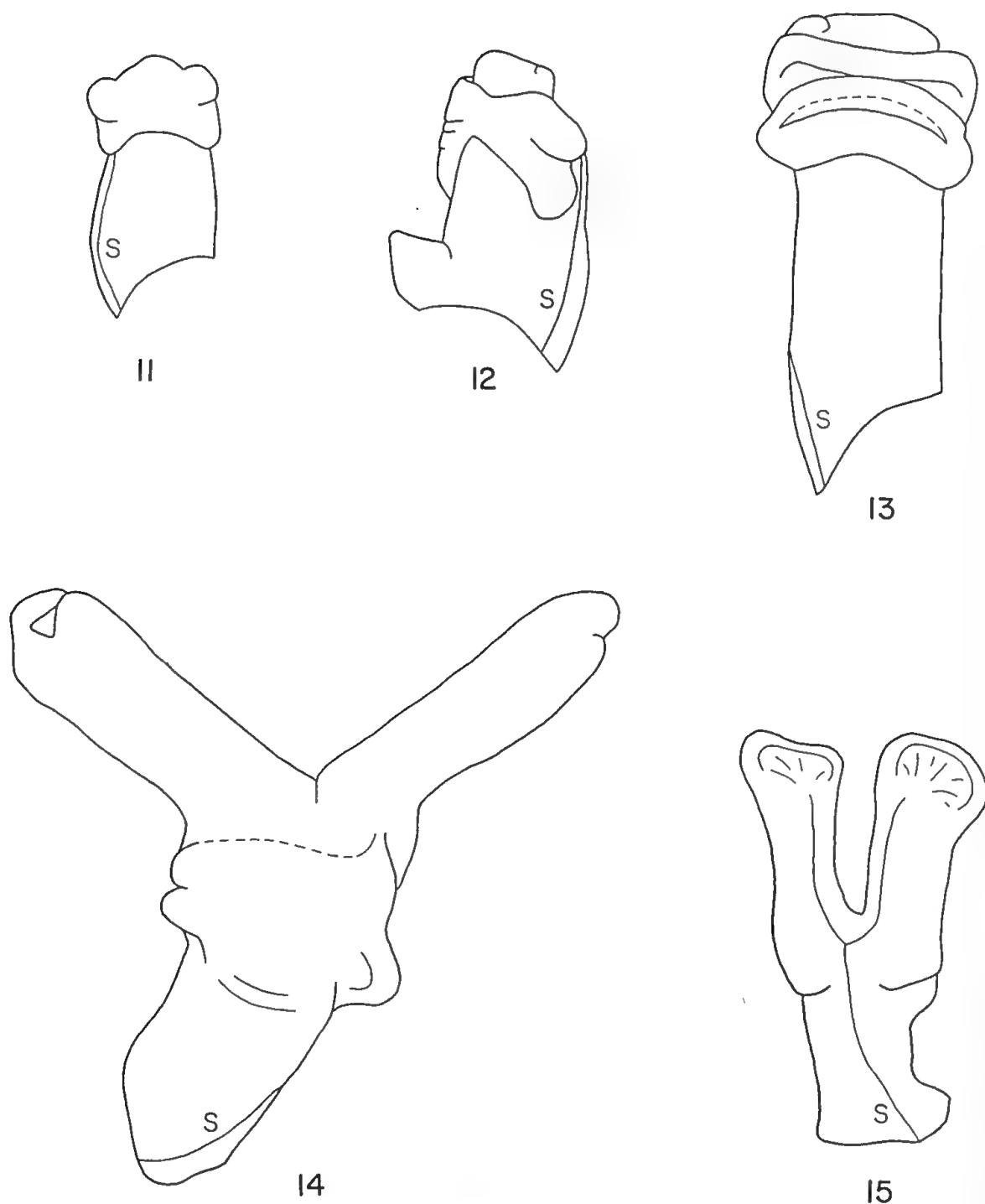
I have not examined the hemipenis of any gerrhosaurine but in that both *Eumeces* and *Mabuya* have a basically columnar structure, I take this as the primitive condition (H) and the deeply bifurcated structure as derived (h).

THE THREE GROUPS OF SKINKS REPRESENTED IN AUSTRALIA

Egernia Group

DIAGNOSIS: Premaxillary teeth 8 or fewer¹; Meckel's groove completely obliterated by the overlapping and fusion of dentary; parietals completely separated by interparietal; parietal bordered along its posterolateral edge by two or more temporals and a nuchal; medial pair of preanals more or less equal in size to more lateral preanals; scales on dorsal surface of fourth toe in two rows at least basally (the second row is generally made up of only two to four small scales); iris lighter than pupil; hemipenis consisting of short columnar base and bulbous cap.

1. The closely related *Egernia coventryi* and *E. luctuosa* from extreme southeastern and southwestern Australia, respectively, are exceptional in having nine premaxillary teeth (Table 1). In that *Egernia* probably evolved from a rather primitive species of lygosomine (perhaps similar to a living species of southeast Asian *Mabuya*, *fide* Horton 1972) which probably had nine premaxillary teeth, this tooth number may mark *Egernia coventryi* and *E. luctuosa* as primitive within *Egernia*. This supposition is supported by the species' distribution in areas that are well known for harbouring primitive relicts in other groups, e.g. plants (Burbridge 1960) and insects (Mackerras 1970).



Figs. 11-15. The two types of hemipenis in Australian skinks. 11-13, the basically columnar hemipenis of the *Egernia* and *Eugongylus* groups: 11 — *Leiopisma coventryi*; 12 — *Lampropholis challengerii*; 13 — *Morethia obscura*. 14-15, the deeply bifurcated hemipenis of the *Sphenomorphus* group: 14 — *Sphenomorphus gracilipes*; 15 — *Lerista terdigitata*. Right hemipenis (ventral aspect) illustrated for all species except *Lampropholis challengerii*. The sulcus spermaticus is indicated by the letter "s".

Australian Genera.

Egernia. The recent work of Cogger (1975) and Storr (1978a) brings the total number of currently recognised species to 27; one of these, *cunninghami*, however, is widely recognised to be composite.

The genus is widespread throughout Australia (including Tasmania) and one Australian species extends north into southern New Guinea.

Tiliqua (including *Omolepida* and *Trachydosaurus*). A total of 11 species are now recognised as the result of work by Cogger (1975) and Storr (1976c).

The genus is widespread throughout Australia with one species or subspecies (*gigas*) extending north through New Guinea and west through the Sunda Islands to Sumatra.

Non-Australian Genera.

The Giant Green Tree Skink of the Solomon Islands, *Corucia zebrata*, is definitely a member of this group. The bizarre, spiny skinks of the genus *Tribolonotus* from New Guinea, the Bismarck Archipelago and the Solomon Islands (Zweifel 1966, Greer and Parker 1968a and Cogger 1972) also appear to belong here.

Eugongylus Group

DIAGNOSIS: Premaxillary teeth 11 or more; Meckel's groove completely obliterated by the overlapping and fusion of dentary; parietals meet behind interparietal; parietal bordered along its posterior edge by upper secondary temporal and transversely enlarged nuchal; medial pair of preanal scales more or less equal in size to more lateral preanals; scales on dorsal surface of fourth toe in single row throughout length of digit; iris lighter than pupil; hemipenis consisting of short columnar base and bulbous cap.

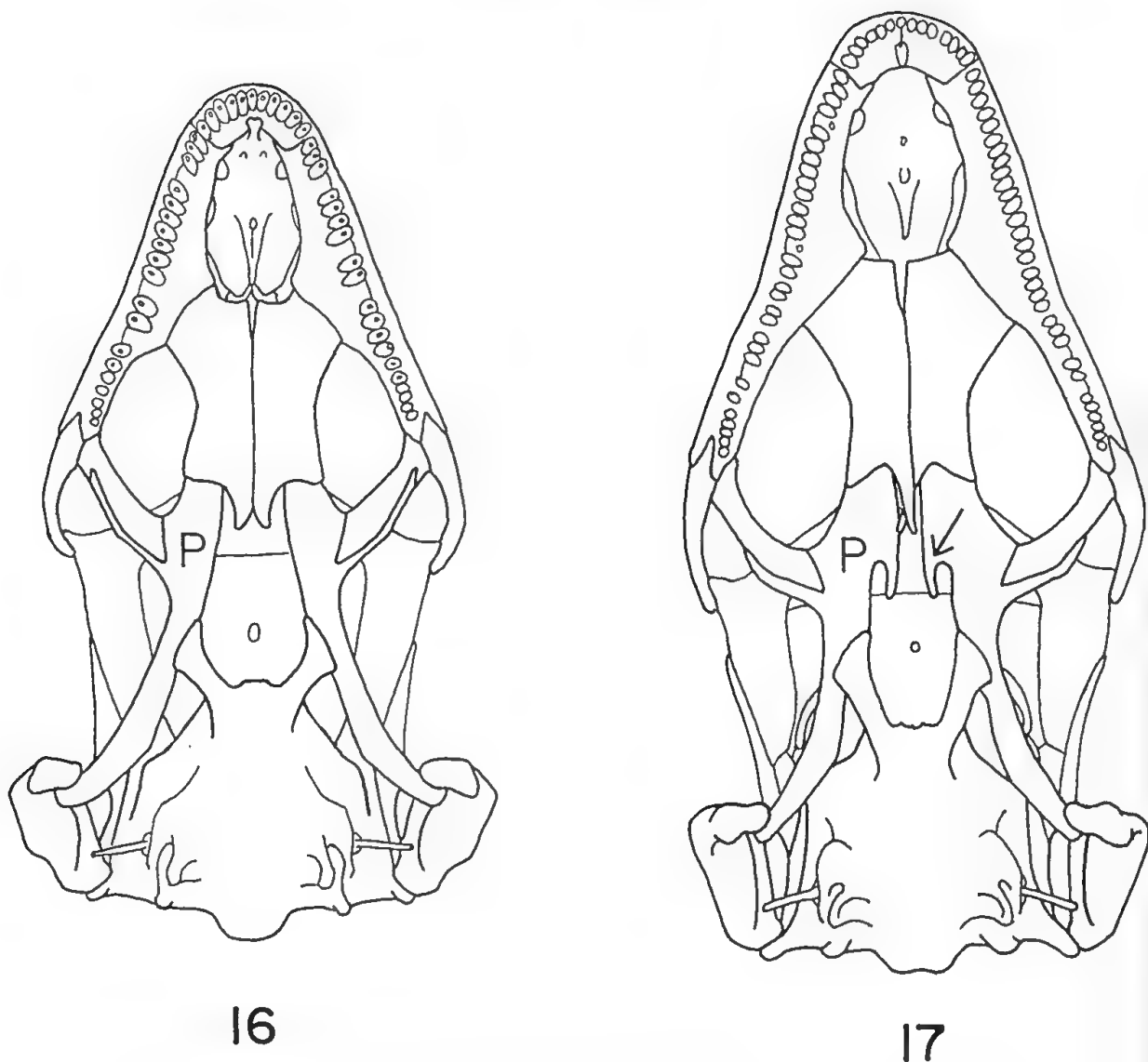
Subgroups of the *Eugongylus* group

There are two major subdivisions of the *Eugongylus* group based on the shape of the palatal rami of the pterygoids (Greer 1974). In the more primitive alpha condition, the palatal rami diverge smoothly along their medial edges (Fig. 16 this paper and Figs. 1-11 in Greer 1974), whereas in the advanced beta condition, the palatal rami each have a deep posterior emargination that gives them a distinctly hooked appearance (Fig. 17 this paper and Figs. 12-17 in Greer 1974).

Eugongylus* Subgroup (Alpha Palate)Australian Genera*

Anotis. Five species are currently recognised, two in south-eastern Australia (but not Tasmania) and three on New Caledonia (Greer 1974).

Cryptoblepharus. Thirty-six forms of this widespread genus are currently recognised (Mertens 1928, 1931, 1933, 1934, 1958 and 1964, Storr 1976a and Ingram and Covacevich, 1978). In the past, all forms were generally treated as subspecies of one species (*boutoni*)



Figs. 16-17. The two types of secondary palate in the *Eugongylus* group: 16, the alpha palate of the *Eugongylus* subgroup (*Leiolopisma pretiosum*); 17, the beta palate of the *Lampropholis* subgroup (*Carlia longipes*).

but the increasing number of cases of sympatry now make it more reasonable to regard most of these forms as species.

In addition to being widespread throughout Australia (but not in Tasmania), the genus occurs widely in the tropical western and central Pacific area and on islands in the far western Indian Ocean and the adjacent African mainland.

*Emoia*¹ Dr Walter Brown is revising this large and difficult group, and he currently recognises 37 species (letter of 22 September 1976).

1. A few species of *Emoia* have apparently evolved a beta palate independently of the *Lampropholis* subgroup discussed below (see Greer 1974, p. 13).

The genus is widespread in the tropical Pacific area from southeast Asia east to Arundel Island but enters Australia only in extreme northeastern Cape York Peninsula (Ingram, MS).

Eugongylus. Three species are currently recognised, but a review of the species taxonomy is badly needed.

The genus is widespread throughout the southwest Pacific but, like *Emoia*, enters Australia only in extreme northeastern Cape York Peninsula.

Leiolopisma (including *Pseudemoia*). A total of 41 species is currently recognised. The genus is centred over three disjunct areas: Australia and Tasmania (12 species); New Zealand and the Chatham Islands (21 species), and New Caledonia and the Loyalty Islands (6 species). Mr Peter Rawlinson (1974b and 1975) is currently revising the Australian species, and Mr Graham Hardy (1977) and Dr Joan Robb (1970, 1974 and in preparation) have revised the New Zealand species; our knowledge of the important New Caledonia and Loyalty Island fauna, however, is based solely on the egregiously outdated review of Roux (1913). In addition to these areas, the genus is also represented by single species in the Mauritius area (Vinson and Vinson 1969) and Lord Howe Island (Cogger 1971).

Morethia. This widespread Australian (but not Tasmanian) genus has been the subject of three recent reviews (Smyth 1972, Storr 1972, and Rawlinson 1976). Seven named species are known and an eighth from the Northern Territory will soon be described (Greer, MS).

Proablepharus. A recent review of Western Australian material by Storr (1975c) recognised two species and to these, I believe, should be added the little known *kinghorni* from the drier parts of eastern Australia (Greer 1974).

The genus is widespread throughout most of mainland Australia except for the more mesic southeast and southwest areas.

Non-Australian Genera

The very rare genera *Phoboscincus* of New Caledonia and the Loyalty Islands and *Tachygyia* from the Tonga Islands are members of the *Eugongylus* subgroup (Greer 1974). Four species currently placed on the genus *Sphenomorphus* also probably belong here. These are *aignanus*, *bignelli*, *louisiadensis* and *minutus* from the New Guinea — Solomon Islands area (per. obs.).

Lampropholis Subgroup (Beta Palate)

Australian Genera

Carlia. The genus is centred over northern Australia and New Guinea. The species of this genus that occur in Australia are currently being revised by Ingram and Covacevich (MS), and they recognise 21 species. A similar revision of the remaining species, which may nearly equal the Australian species in number, is badly needed.

Lampropholis. Mr Peter Rawlinson is currently revising the species in the genus. I personally know of at least 11 or 12 species, although common practice recognises only four (Cogger 1975). The genus is confined to the mesic east coast of Australia (including Tasmania) and has been introduced to both New Zealand and the Hawaiian Islands. In Hawaii the introduced species (cf. *delicata*) is commonly misidentified as *Leiolopisma metallicum* (Rawlinson, pers. comm. and pers. obs.).

Menetia. The recent reviews of Storr (1976b and 1978b) and Ingram (1977) recognise a total of six species, and one more remains to be described (Rankin, MS).

The genus is widespread throughout most of mainland Australia except for the more mesic southeast and southwest areas and Cape York Peninsula.

Non-Australian Genera

The only non-Australian member of the *Lampropholis* subgroup in the southwest Pacific area appears to be *Geomyersia*, a rare monotypic endemic of the Solomon Islands (Greer and Parker 1968 b). In subsaharan Africa, however, there are a large number of skinks that are certainly members of the *Eugongylus* group and, unless the shape of the palatal rami of the pterygoids is convergent, they are also members of the *Lampropholis* subgroup. These skinks are currently in the genera *Cophoscincopus* (Greer 1974) and *Panaspis*, the latter with the four subgenera *Afroablepharus*, *Lacertaspis*, *Leptosiaphos* and *Panaspis* (Perret 1975).

The four poorly known south Indian skinks of the genus *Ristella* (Smith 1935) may also be members of the *Lampropholis* subgroup.

Sphenomorphus Group

DIAGNOSIS: Premaxillary teeth 9 in most surface dwelling forms but fewer in some burrowing forms and in *Ctenotus*; Meckel's groove open; parietals meet behind interparietal; parietal bordered along its posterolateral edge by two or more temporals; and a nuchal; medial pair of preanals moderately to much larger than more lateral preanals; scales on dorsal surface of fourth toe in two or more rows extending over at least basal half of digit; iris virtually as dark as pupil; hemipenis consisting of relatively long thin base and two long thin bifurcations.

Australian Genera

Anomalopus. Work in preparation by Greer and Cogger indicates that a total of 11 species is recognisable, but only seven of these are named. The group is almost certainly polyphyletic and will probably be split into three genera. The assemblage as it is now conceived occurs only in eastern Queensland and New South Wales.

Ctenotus. Thanks largely to Storr's (1968, 1969, 1971a, 1973, 1975a and 1978 c-d) revisionary efforts with the genus, 53 species are currently recognized. There are, however, several species yet to be described (Mr P. R. Rankin and Dr G. M. Storr) and the total number of species in the genus probably exceeds 60.

The genus is widespread throughout Australia (but not Tasmania), and two Australian species extend north into southern New Guinea.

Eremiascincus. Two species are currently recognised (Storr 1967 and 1974a and Greer 1979) but there is still a good deal of unexplained variation within the complex which indicates that more remains to be done with the alpha taxonomy of the group.

The genus is widespread in the arid and semi-arid interior of mainland Australia.

Hemiergis. Four species are currently recognised (Copland 1945, Smyth 1968, Storr 1975b and Coventry 1976). The genus is restricted to the southern periphery of temperate Australia but does not occur in Tasmania.

Lerista. A total of 34 species is now recognised (Storr 1971b and 1976d and Cogger 1975), and there are at least three additional species that have yet to be described. The genus occurs throughout most of Australia and extends through the islands of eastern Bass Strait to the extreme northeastern corner of Tasmania.

*Notoscincus*¹ This genus is currently thought to comprise either a single species with two subspecies (Storr 1974b) or two species (Smith 1976). The known localities are widely scattered throughout the arid, semi-arid and seasonally dry areas of northern Australia.

Saiphos. This monotypic genus is known only from the mesic east coast of New South Wales and southeastern Queensland (Cogger 1975).

Sphenomorphus. This is a very large and diverse, but probably largely monophyletic, group ranging from southwestern India and southern and eastern Asia east through the Philippines and Indo-Australian Archipelago to Australia and the Solomon Islands (Greer 1973, Greer and Parker 1967 and 1974 and Storr 1967). The group may also be represented in Middle America (Greer 1974). There are over 125 described species and many underscribed species are known. The group merits subdivision at the generic level.

"*Tropidophorus*" *queenslandiae*. This peculiar species is restricted to the rainforests of northeastern Queensland (Cogger 1975). In my opinion it is unlikely to be closely related to the "true" *Tropidophorus* of southeast Asia, Borneo and the Philippines; instead it is probably a bizarre offshoot of the *Sphenomorphus* radiation in Australia.

Non-Australian Genera

Three southwest Pacific genera are probably members of this group. These are *Lipinia*, *Lobulia* and *Prasinohaema* (Greer 1974). Also, if *Tribolonotus* is not a member of the *Egernia* group, it probably belongs here.

Several primarily Asian genera are also probably members of this group. They are *Ablepharus*, *Ateuchosaurus*, *Isopachys*, *Scincella* and *Tropidophorus*.

THE PHYLOGENETIC RELATIONSHIPS OF THE THREE GROUPS OF SKINKS REPRESENTED IN AUSTRALIA

In addition to the eight characters analyzed in an earlier section of this paper there are two other characters that are useful in inferring the relationships of the three groups of skinks represented in Australia. These are the presence (I) or absence (i) of pterygoid teeth and the presence (J) or absence (j) of a distinct postorbital bone. In both cases the presence of the structure is primitive and its absence derived (Camp 1923). Pterygoid teeth and a postorbital bone occur in a few members of the *Sphenomorphus* group and hence must have characterized its earliest representatives², but neither structure occurs in any member of the *Eugongylus* or *Egernia* group.

1. In an earlier paper (Greer 1974) I suggested that the genus *Notoscincus* was a member of what is here considered to be the *Eugongylus* group. At that time the basis for my concept of the genus was a single, poorly preserved specimen and a drawing of the ventral view of the skull (Fuhn 1969). Since then, however, I have examined all the preserved material in the Australian state museums and, through the courtesy of Dr. Glen Storr of the Western Australian Museum, I have been able to prepare and examine the skull of a single specimen (W.A.M. 45642). I have also examined six living specimens. As a result of these studies, I now think that *Notoscincus* is more likely a member of the *Sphenomorphus* group than the *Eugongylus* group. The reasons for this are that in only two of the seven characters in which the two groups differ, i.e., Meckel's groove (closed) and the supradigital scales on the fourth toe (in a single row), *Notoscincus* is most similar to the *Eugongylus* group, but in the remaining five characters, i.e., premaxillary teeth (7-9), scales along the posterolateral edge of the parietal (a transversely enlarged nuchal and two temporals), preanals (enlarged), iris colour (dark) and hemipenial morphology (deeply bifurcated), the genus is most similar to the *Sphenomorphus* group.

2. These two characters were omitted from the earlier analysis because they were not completely diagnostic for all groups.

Assuming that the phyletic analysis for all ten characters is correct and that no retrogressive changes of character state have occurred, then the three most parsimonious phylogenies relating the three groups of skinks represented in Australia are depicted in Fig. 18. The first phylogeny (a) hypothesizes 15 changes of character state and four cases of convergence ($B \rightarrow b$, $C \rightarrow c$, $I \rightarrow i$, and $J \rightarrow j$); the second (b) hypothesizes 14 changes of character state and three cases of convergence ($C \rightarrow c$, $I \rightarrow i$ and $J \rightarrow j$), and the third (c) hypothesizes 12 character state changes and one case of convergence ($C \rightarrow c$). On the basis of this analysis, therefore, the third phylogeny is the most parsimonious and hence the most reasonable as a working model.

Two observations can be made about the relationships hypothesized by this phylogeny. First, somewhere in the line between the common ancestor of the *Eugongylus* and *Egernia* groups and the common ancestor of all three groups there may have been a form similar to *Mabuya* (AbCDEFGHIJ). Furthermore, in that this form probably had a scaly lower eyelid, divided frontoparietals and an oviparous mode of reproduction (as evidenced by the retention of these primitive characters in living members of the *Eugongylus* and *Egernia* groups), it was probably most similar to the most primitive species of *Mabuya* living today. The second observation is that while the common ancestor of all three groups was itself probably rather similar to the most primitive living species of *Mabuya*, it was even slightly more primitive in having had an open Meckel's groove. It is interesting to note that no known living lygosomine is as generally primitive as this hypothetical form.

THE ZOOGEOGRAPHIC ORIGIN OF AUSTRALIAN SKINKS

Two independent lines of evidence indicate that, in the broadest terms, the area of origin of the Australian skink fauna lies to the north and northwest of present day Australia. First, the nearest living relatives of the ancestors of the three groups of skinks represented in Australia appear to be the most primitive living species of *Mabuya* (see above), and the fact that these forms are centred over southcentral and southeast Asia and the western end of the Indo-Australian Archipelago suggests that this area may have been coincident with or close to the area of origin of the three groups (also see below). And second, there is nothing in the distribution of skinks as a whole that suggests that any skink ever used a Gondwanaland dispersal route. None of the three groups represented in Australia, for example, occur in South America and the only group of skinks in South America (the most advanced species of *Mabuya*) is not represented in Australia¹

It is not yet possible to say how many times skinks may have colonized Australia, because knowledge of relationships within the three groups is incomplete. An educated guess as to the number of significant colonizations, i.e., those that led to speciation, however, would be somewhere in the range of two to eight. The minimum estimate is based on two lines of reasoning. First, the most primitive members of the *Sphenomorphus* group are centred over southeast Asia and the western end of the Indo-Australian Archipelago (Greer 1974 and 1978) and hence the group as a whole may have evolved here and then spread east to enter Australia at least once. And second, if the *Egernia* and *Eugongylus* groups did share a common ancestor, as the evidence discussed above seems to indicate, then the fact that both groups are centred over the Australian Region raises the possibility that this ancestor inhabited Australia and that one of its ancestors was itself a colonist of Australia. The maximum estimate is based on my own ideas about relationships

1. The presence of certain derived character states in the South American *Mabuya*, e.g., a clear window in the lower eyelid and viviparity, makes it unlikely that these species, more than the Asian species, are the closest living relatives of the three groups of skinks discussed here.

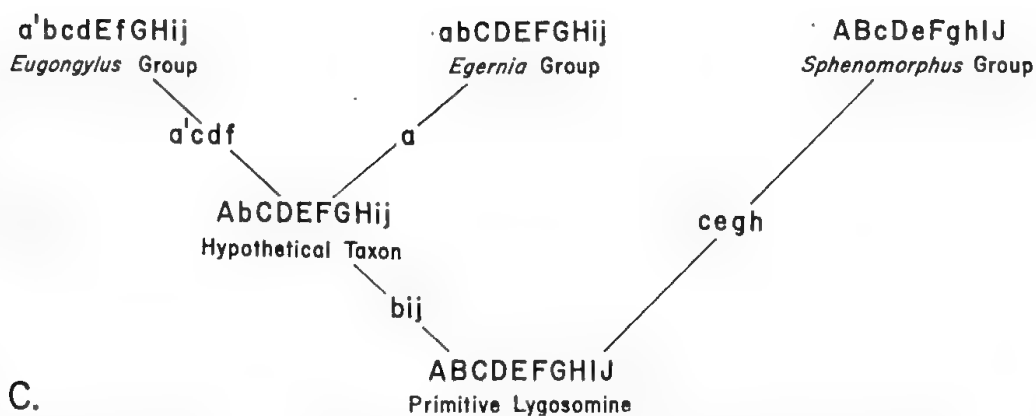
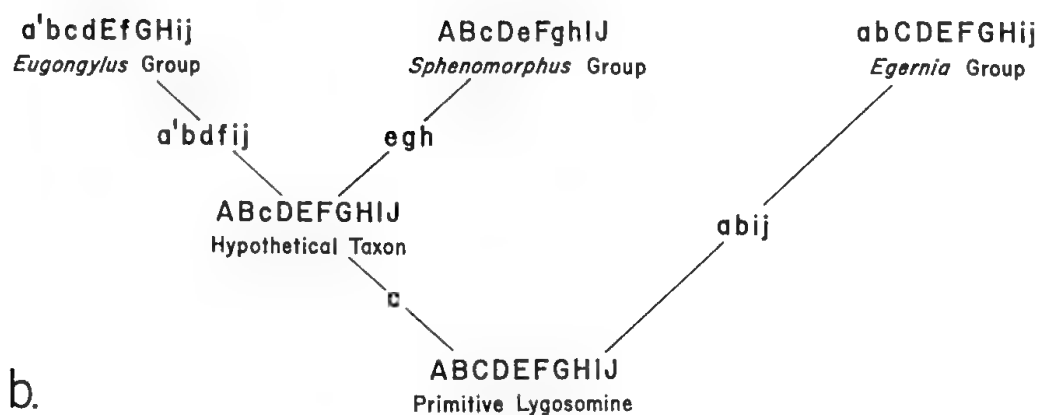
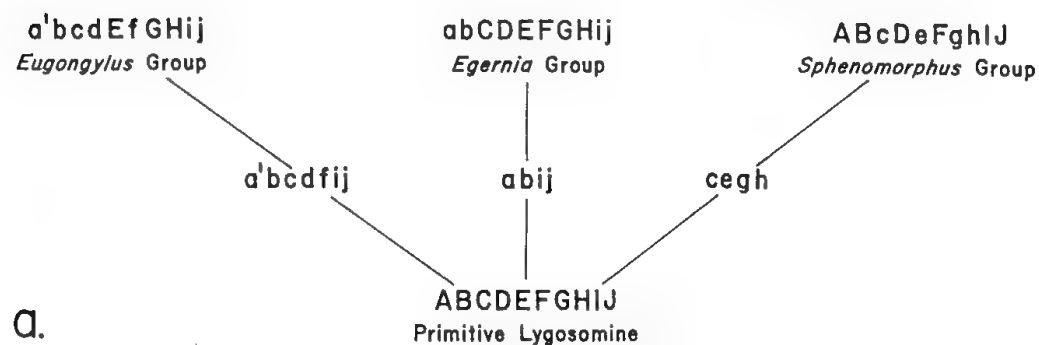


Fig. 18. The three most parsimonious phylogenies for the three groups of skinks represented in the Australian fauna. Each letter denotes a character, and the letter case denotes the inferred primitive (upper case) or derived (lower case) state of the character. Changes in character state between taxa are indicated by the letters beside the lines linking the taxa. Note that the number of character state changes and cases of convergence hypothesized by the first (a), second (b) and third (c) phylogenies are, respectively, 15 and four, 14 and three and 12 and one. See the text for the assumptions and rationale behind the phylogenies.

within the *Eugongylus* and *Sphenomorphus* groups, but since there is still much to be learned about relationships in both groups, but especially the *Sphenomorphus* group, the overall maximum estimate is highly speculative.

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APPENDIX

The Primitive Features of *Eumeces* and *Mabuya*

Eumeces and *Mabuya* appear to be the most generally primitive genera in their respective subfamilies, i.e., the Scincinae and Lygosominae. They are also very similar to each other, differing primarily in the two characters that distinguish their respective subfamilies, i.e., the distinct frontal bones and generally incomplete secondary palate of the scincines versus the fused frontals and generally complete secondary palate of the lygosomines (Greer 1970 a).

The character states which mark these two genera as the most generally primitive taxa within their subfamilies and which would be nearly universally accepted as primitive within skinks as a whole are outlined briefly below.

EXTERNAL MORPHOLOGY. Supranasal scales present; prefrontals present; single anterior and posterior loreal scales; frontoparietal and interparietal scales distinct; lower eyelid moveable and scaly; external ear opening present; fore and hind limbs well developed, pentadactyl; claws non-retractile.

OSTEOLOGY. Premaxillary bones distinct; nasals distinct; lacrimal present; squamosal present; postorbital distinct; supratemporal arch complete; post-temporal arch open; jugal present and extending dorsally to postfrontal; parietal eye foramen present; pterygoid teeth present; palatal rami of pterygoids separated in the secondary palate (applicable only to lygosomines); fenestra rotunda present; angular distinct; second epi and ceratobranchials present, caudal vertebrae with fracture planes.

INTERNAL ANATOMY. Oviducts paired.

BEHAVIOUR. Gait normal, i.e., not slow and deliberate.

ECOLOGY. Diurnal; surface dwelling (terrestrial to semi-arboreal).

REPRODUCTION. Oviparous; clutch size variable.

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[illegible]

Taxon	Number of premaxillary teeth																
	4	5	6	7	8	9	10	11	12	13	14	15	16	17			
<i>Cryptoblepharus</i>																	
<i>litoralis</i>								10	1								
<i>virgatus</i>								12									
species 1								8	1								
<i>Emoia</i>																	
<i>atrocostata</i>								11									
<i>cyanogaster</i>							1	20	1								
<i>Eugongylus</i>																	
<i>albofasciolatus</i>							2	1	5								
<i>rufescens</i>							1	7									
<i>Leiopisma</i>																	
<i>coventryi</i>							1	10	3								
<i>entrecasteauxii</i>							1	17	1								
<i>lichenigerum</i>							3	6									
<i>metallicum</i>								5									
<i>platynotum</i>						1		22	2								
<i>pretiosum</i>								9									
<i>trilineatum</i> (east coast)							1	5									
<i>trilineatum</i> (west coast)								32									
<i>spenceri</i>							1	11									

Taxon	Number of premaxillary teeth											12	13	14	15	16	17
	4	5	6	7	8	9	10	11	10	9	8						
<i>Morethia</i>																	
<i>adelaidensis</i>								5									
<i>boulengeri</i>							1	33				1					
<i>butleri</i>								14									
<i>lineoocellata</i>								5									
<i>obscura</i>								16				1					
<i>ruficauda</i>								3									
<i>taeniopleura</i>								10									
<i>species 1</i>								1									
<i>Proablepharus</i>																	
<i>kinghorni</i>								3									
<i>reginae</i>								1									
<i>tenius</i>								3									
<i>Lampropholis</i> Subgroup																	
<i>Carlia</i>																	
<i>amax</i>												5					
<i>bicarinata</i>												6	1		1		
<i>burnettii</i>												3			4		
<i>coensis</i>															1		
<i>dogare</i>													2				

Taxon	Number of premaxillary teeth													
	4	5	6	7	8	9	10	11	12	13	14	15	16	17
<i>gracilis</i>										2				
<i>jarnoldae</i>										8	1	3		
<i>johnstonei</i>										4				
<i>melanopogon</i>									1	38	1	2		
<i>mundivensis</i>									1	3				
<i>novaeagueineae</i>												11		
<i>pectoralis</i>										9				
<i>rhomboidalis</i>										2	1	1		
<i>rimula</i>												3		
<i>schmeltzii</i>										2				
<i>tetradactyla</i>								1		12				
<i>vivax</i>										5	2			
<i>species 1</i>										1	3	13		1
<i>Lampropholis</i>														
<i>challengeri</i>								5						
<i>delicata</i>						1	1	46	4	1				
<i>guichenoti</i>							1	18	2					
<i>mustelina</i>								30	1					
<i>species 1</i>								13	1					
<i>species 2</i>								8						

Number of premaxillary teeth

Taxon	4	5	6	7	8	9	10	11	12	13	14	15	16	17
species 3							1	3						
species 4										9	3			
species 5								1		13	1			
<i>Menetia</i>														
<i>greyi</i>							1	11						
<i>maini</i>								4						
<i>surda</i>								1						
SPHENOMORPHUS GROUP														
<i>Anomalopus</i>														
<i>frontalis</i>				2										
<i>lentiginosus</i>				13										
<i>ophioscincus</i>										2	6			
<i>reticulatus</i>										2				
<i>truncatus</i>								2			4			
<i>verreauxii</i>						1		11						
species 1														
species 2								1						
species 3						1		4						
species 4														
						8								

[illegible]

Taxon	Number of premaxillary teeth												
	5	6	7	8	9	10	11	12	13	14	15	16	17
<i>isolepis</i>				1	5								
<i>kosciuskoi</i>			1	5									
<i>mjobergi</i>					1								
<i>murrayi</i>			2	8									
<i>nigricaudis</i>				1									
<i>pardalis</i>				1	3								
<i>punctulatus</i>				8	8								
<i>quoyii</i>					9								
<i>scutirostrus</i>				3	26								
<i>tenuis</i>			1	2	5								
<i>tigrinum</i>					4								
species 1						10	1						
species 2				1									
" <i>Tropidophorus</i> "													
<i>queenstandiae</i>							6						

A New *Sphenomorphus* (Lacertilia: Scincidae) from the Rainforests of Northeastern Queensland

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For several years Australian herpetologists familiar with the lizards of northeastern Queensland have been aware that there was a large undescribed species of skink associated with the rainforests between Cooktown and the Tully River on the Atherton Tableland. The new species was recognized to be similar to *Sphenomorphus nigricaudis* a Papuan-Australian species that reaches the southern limit of its distribution at the base of Cape York Peninsula (Cogger 1975 and Greer 1979). The new species was never collected in large numbers, but over the years the number of specimens has slowly grown to where there are now a total of 36. I have recently examined all of this material and in this paper I present a formal description of the species, summarize its natural history and discuss its relationships.

In naming the species I wish to draw attention to the dusky brown tail that characterizes most large specimens and hence I propose the name

***Sphenomorphus fuscicaudis* n.sp.**

(Figs. 1,3)

HOLOTYPE: Queensland Museum J 25218 — Top of Mt. Finnigan (3,700 ft.), Mt. Finnigan National Park, northeastern Queensland. Collected on 9 November 1974 by Ms Jeanette Covacevich and Mr Keith McDonald.

PARATYPES: All localities are in northeastern Queensland between Cooktown and the Tully River on the Atherton Tableland.

Australian Museum: R 10829 — Atherton Tableland, no date; R 29539 — Lake Barrine, 15 October 1969; R 30359 — Danbulla State Forest, approx. 20 miles N. Cairns (sic ?), 30 August 1970; R 54635 — Atherton Tablelands, no date; R 56561 - 56562 — southern base of Thornton Peak, 16° 13' S., 145° 22' E., 23 July 1976; R 57061 - 57062 — Palmerston Highway near Millaa Millaa, 7 January 1976; R 57131 — southern base of Thornton Peak, 24 July 1976; R 60772 - 60773 — 9.6 km N. of the Kennedy Highway near Kuranda via the Black Mountain road, 18 July 1976; R 60774 — approx. 10.8 km W. of the Mossman - Mt. Molloy road via the Mt. Lewis forestry road, Mt. Lewis, 21 July 1976; R 61299 — Millaa Millaa, January 1977.

Museum of Comparative Zoology: 112059 - 112060 — Mt. Hartley (2000 ft.), 12 July 1968; 112061 - 112062 — Home Rule, Slaty Creek (600 ft.), 2 June 1968; 128634 — Speewah (1000 ft.), 14 February 1971; 111269 - 111270 — Big Tableland, 6 June 1968.

National Museum of Victoria: D 1277 — Queensland, no date.

Queensland Museum: J 15807 — Crystal Cascades, near Cairns, no date; J 25220 — just W. of Obree Point, E. of Home Rule, 17 November 1974; J 25221 — near "The Granites", Home Rule, 17 November 1974; J 25135 — Mt. Finnigan National Park (2600 ft.), 10 November 1974; J 25142, 25144 - 25145 — slopes of Mt. Hartley, 30 October 1974; J 25273 — Mt. Hartley, 6 November 1974; J 25288 — near Home Rule, on tract to "The Granites", 11

November 1974; J 22666 — Big Tableland (approx. 2300 ft.), approx. 20 km S.E. of Cooktown, 3 January 1972; J 29074 - 29075 — "A" road (720 m.), Danbulla State Forest, Atherton Tableland, 17° 07' S., 145° 38' E., 4 October 1974; J 29076 - 29077 — Lake Eacham National Park (780 m.), 17° 17' S., 145° 28' E., 19, 21 September 1974.

DIAGNOSIS. In the Australian fauna *Sphenomorphus fuscicaudis* can be distinguished from all but three other species of *Sphenomorphus* on the basis of the following three characters in combination: body scales in 26-30 longitudinal rows at midbody, two infralabials in contact with the postmental on each side, and the fifth supralabial situated directly below the centre of the eye. The three other species which could show these three characters in combination are *nigricaudis* and *tigrinum* which are restricted to northeastern Queensland and *tenuis* which occurs widely along the east coast between the McIlwraith Range on Cape York and the vicinity of Milton, New South Wales.

Sphenomorphus fuscicaudis differs from both *tenuis* and *tigrinum* in having relatively short limbs which would be widely separated if adpressed to the body instead of relatively long limbs which would overlap at the digits if adpressed to the body (Table 1) and in having dark vermiculations or vague vertical bars in the area of the shoulder (Figure 1 this paper and Figure 620 in Cogger 1975) instead of a dark serrated stripe on the upper flanks as in *tenuis* (Figure 626 in Cogger 1975) or a series of small dark blotches along the dorsolateral line as in *tigrinum*. *Sphenomorphus fuscicaudis* also differs from *tenuis* in being oviparous instead of viviparous, and it differs from *tigrinum* in having the prefrontal scales almost invariably separated instead of generally meeting (Table 1).

Sphenomorphus fuscicaudis is most similar to *nigricaudis* in that they overlap broadly in most standard scale counts (Table 1), and they both have similar limb proportions, separated prefrontals and a colour pattern featuring dark crossbands on the anterior part of the body (Figures 1 - 2 of this paper; also compare Figure 620 of *fuscicaudis* with Figures 619 and 621¹ of *nigricaudis* in Cogger 1975).

Sphenomorphus fuscicaudis differs from *nigricaudis*, however, in being slightly more gracile, in having fewer nuchal scales (1-4, mode = 2 versus 3-5, mode = 4) but more scales in the paravertebral rows (60-70 versus 52-58 counted from the level of the posterior part of the thigh to the parietal), and in having both the dark crossbanding less well developed (especially mid-dorsally) and the dark bands separated in the anterior dorsolateral area by light cream coloured blotches instead of the general ground colour (Figures 1-2).

DESCRIPTION. In general aspect *Sphenomorphus fuscicaudis* is a large (maximum snout-vent length = 91 mm), slightly attenuate skink with moderately short, pentadactyl limbs. It is light brown above with black crossbands or vermiculations which are most strongly developed in the region of the shoulder and which are separated in this region by light cream coloured blotches in the dorsolateral line (Figure 1).

The details of squamation are as follows: rostral slightly wider than deep, with a broadly rounded lobe projecting onto dorsal surface of snout between nasals; frontonasal appreciably wider than long, forming short rounded suture with frontal; prefrontals large, generally separated medially (.97) but rarely in contact (.03); frontal longer than wide and broadly rounded posteriorly; supraoculars four, first two on each side in contact with frontal; frontoparietals and interparietal distinct and all about equal in length; interparietal with a light parietal eye spot in posterior lobe; parietals meet behind interparietal; nuchals transversely enlarged, 1-4 (mode = 2) on each side; anteriormost nuchal and upper secondary temporal generally separated along the posterolateral edge of parietal by a single smaller temporal.

¹ The specimen in this figure is misidentified as *Sphenomorphus pardalis*.

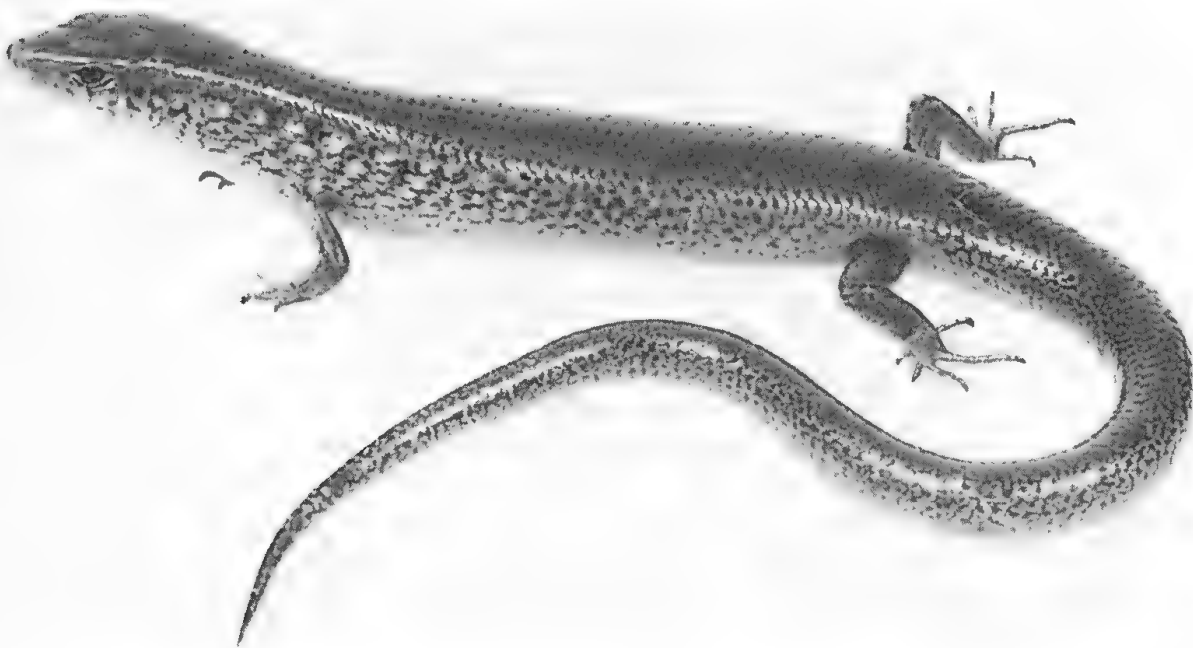


Figure 1. Photograph of *Sphenomorphus fuscicaudis* (A.M. R54635) from the Atherton Tableland, northeastern Queensland. SVL of specimen = 85 mm. Photo: H. G. Cogger.



Figure 2. Photograph of *Sphenomorphus nigricaudis* (A.M. R43898) from Yorke Island, Torres Strait, Queensland. SVL of specimen = 83 mm. Photo: H. G. Cogger.

Nasal moderate in size with relatively large external naris; loreals two, equal in size, anteriormost in broad contact with first supralabial; lower eyelid scaly; supraciliaries 7-9 (mode = 8), first and last largest; preoculars two; suboculars seven, in continuous series below eye; postoculars two; one relatively small primary temporal followed by two appreciably larger secondary temporals; supralabials seven, generally fifth (.97) but rarely fourth (.03) situated directly below centre of eye; infralabials six; external ear opening slightly vertically oval in shape, without lobules; tympanum moderately recessed; mental wider than long; postmental longer than mental, in contact generally with first two infralabials on each side (.97) but rarely with only first infralabial (.03) (Figure 3).

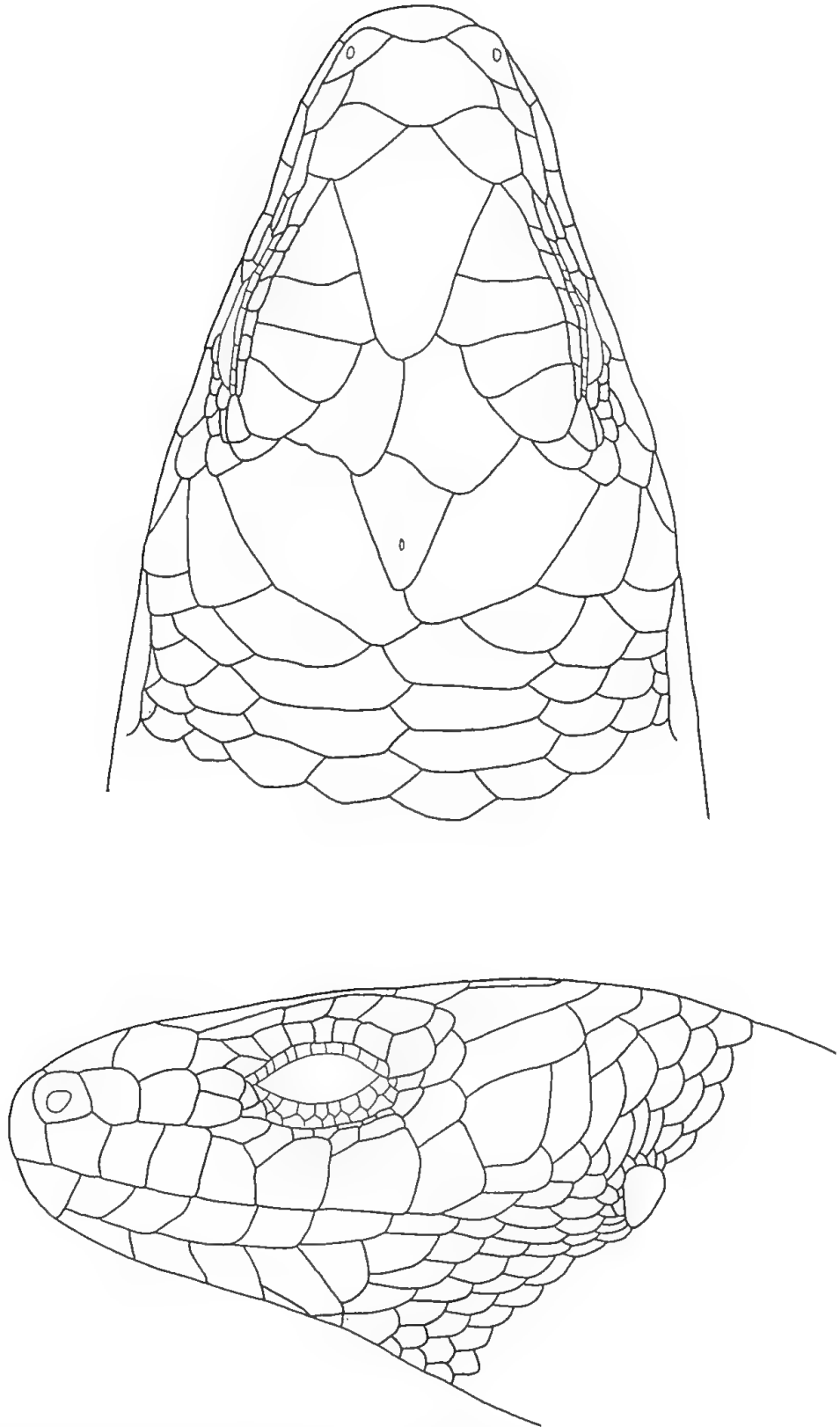


Figure 3. Line drawing of the dorsal (top) and lateral (bottom) views of the head of the holotype of *Sphenomorphus fuscicaudis* new species (Q.M. J 25218).

Body scales smooth, in 27-30 (mean and mode = 28) longitudinal rows at midbody; scales in paravertebral rows only slightly transversely enlarged and numbering 60-70 (mean = 65.1) when counted from level of hind edge of thigh to parietal; medial pair of preanal scales greatly enlarged; scales in medial subcaudal row slightly wider than long and only slightly larger than those in immediately adjacent row.

Limbs pentadactyl; fourth toe covered with two or more longitudinal scale rows above and by 19-24 (mean = 20.9) obtusely keeled lamellae below.

Snout-vent length 42-91 mm; tail length 1.48-1.76 times SVL ($N = 7$); length of and rear legs .18-.23 and .28-.37 times SVL ($N = 29$), respectively.

COLOUR IN PRESERVATIVE. The dorsal ground colour is light tan to rich brown on the head and body, generally giving way subtly but abruptly to dark brown on the tail just posterior to the vent. It is the slightly darker tail that gives the species its name: *fuscus* — brown; *caudus* — tail.

The top of the head is without pattern except for a thin dark band along the posterior edge of the parietals in most specimens and a similar dark edging to a few other dorsal head scales in a few other specimens. Superimposed on the light tan to brown ground colour is a darker pattern. Dorsally this pattern takes the form of vague crossbands across the neck and anterior part of the body and diffuse random spots on the posterior part of the body; laterally it gives way to a more complex reticulation on the side of the neck, a continuation and intensification of the dorsal crossbanding in the shoulder area, and a heavier, more coalesced spotting posteriorly on the flanks. In the dorsolateral area of the shoulder the dark crossbands are generally separated by very distinct light cream coloured blotches (Figure 1).

The vertical sutures of the upper and lower labials are dark edged and in a few specimens the throat is dark spotted.

COLOUR IN LIFE. In life *Sphenomorphus fuscicaudis* displays several colours that are lost in preservative. The distinctive light dorsolateral spots, for example, vary from cream to pale yellow, and the sides are often suffused with pale yellow. The rims of the eyelids may also be yellow.

The chin and throat appear to be white or greyish white in most specimens but in some the chin and throat are pale yellow. The ventral part of the body is often yellow, generally becoming more intense posteriorly. In some specimens, possibly only in juvenile males, the posterior part of the venter is a pale fleshy coral to pink. The underside of the tail generally varies from white through pale grey to bluish grey but in some specimens the underside of the tail, especially basally, is pale pink. Unfortunately, the available colour notes are not adequate to determine how much of this variation in colour is related to season, sex or age; it seems quite possible, however, that some of the variation can be ascribed to one or more of these factors.

DETAILS OF THE HOLOTYPE. The holotype (Q.M. J 25218) is a large (SVL = 86 mm) gravid female with only half the original tail (the regenerating tip is a small grey cone of tissue). Some of the more important systematic characters of the specimen are as follows: 28 longitudinal scale rows at midbody; 68 paravertebral scales; 7-7 supraciliaries; 22-20 subdigital lamellae on fourth toe; 2-3 transversely enlarged nuchals; external ear opening relatively small for species; chin with scattered brown spots.

DISTRIBUTION. To date the species has been collected in areas of rainforest associated with the coastal mountains and lowlands in the region between the Big

Tableland approximately 25 km south of Cooktown and the southern end of the Atherton Plateau (Figure 4). It is worth emphasizing, however, that some of the most characteristic elements of the rainforests of this area, e.g., *Anomalopus frontalis* and "*Tropidophorus*" *queenslandiae*, extend south to at least the Cardwell Range west of Kennedy (pers. obs.) and as a member of this fauna *Sphenomorphus fuscicaudis* should be looked for south of the Atherton Tableland.

The most inland locality known to date is Millaa Millaa, approximately 45 km from the coast. Altitudinally, the species appears to range from near sea level just east of Obree Point and at Crystal Cascades near Cairns to approximately 1125 metres (3700 ft.) at the top of Mt. Finnigan.

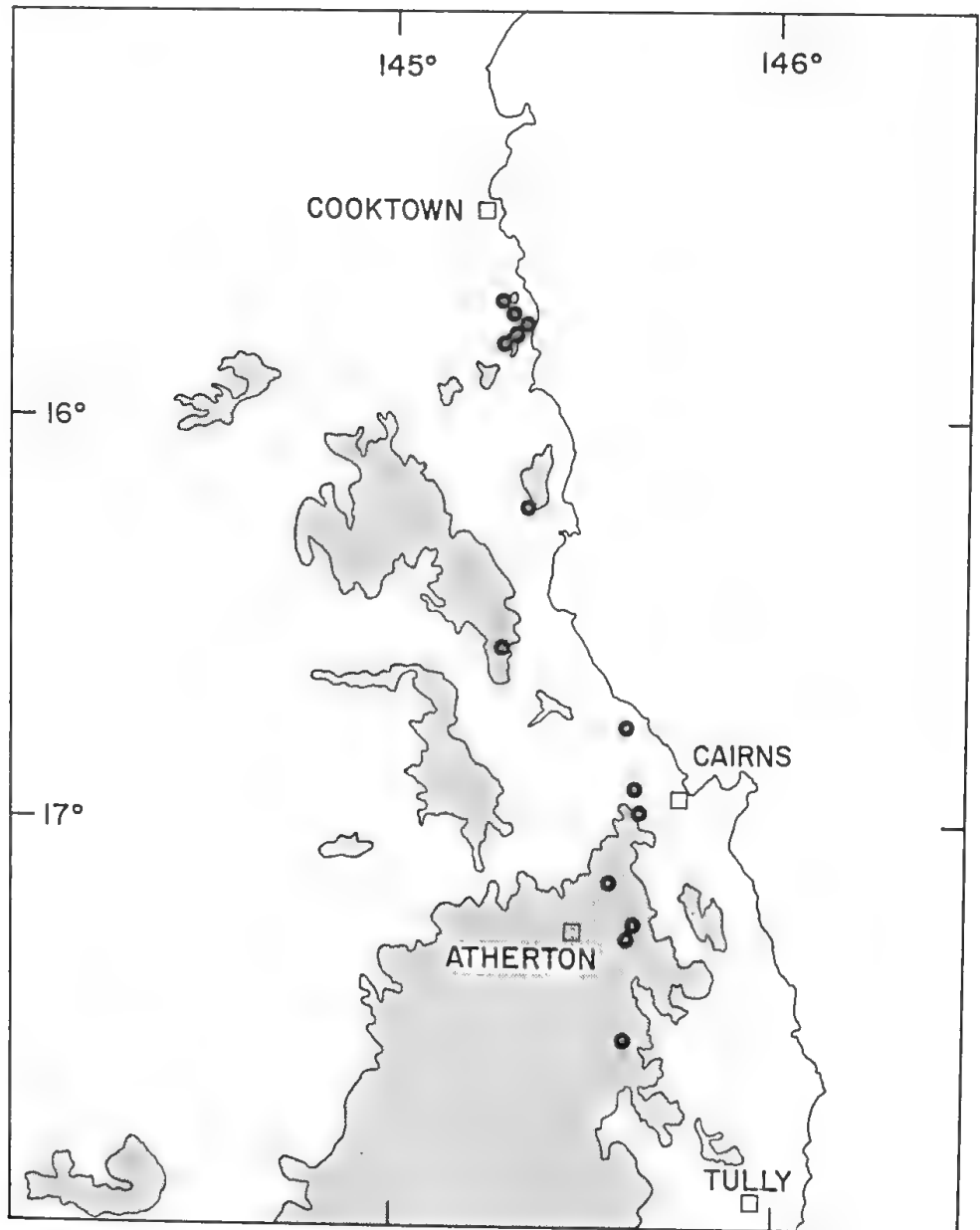


Figure 4. Map of northeastern Queensland showing the distribution of *Sphenomorphus fuscicaudis* (black dots). The area above 610 meters (2000 ft.) is shaded. Some dots represent more than one locality.

FIELD NOTES. The few field notes which accompany museum specimens are worth summarizing here. One specimen (Q.M. J 25220) was found "in a log", another (Q.M. J 25221) was "in a rotten log" and three others (Q.M. J 25142, 25144-25145) were in a "rotting log with *Tropidophorus*." The association with *Tropidophorus queenslandiae* suggests a very moist, closed forest habitat. Such a habitat association is, in fact, mentioned specifically for five specimens: one (Q.M. J 22666) "from under iron in dense closed forest", two (A.M. R 57061-57062) from "under tin on rainforest floor" and two (Q.M. J 29076-29077) from under iron in closed forest. Two specimens (A.M. R 61299 and Q.M. J 25135) have also been recorded from the "edge of rainforest", another (Q.M. J 25273) from a "Casuarina clearing", and two others (Q.M. J 29074-29075) on a "track near closed forest edge".

Mr Fred Parker has collected more specimens of *fuscicaudis* than anyone else, and he has kindly summarized his field notes for me. On the Big Tableland south of Cooktown he found two specimens (MCZ 111269-111270) under old sheets of iron at an abandoned tin mine in open grassland on the plateau at the summit. He notes that these grasslands were probably artificial, resulting from the previous mining activities. All of Parker's other specimens were found in rainforest: at Home Rule (MCZ 112061-112062) one was found under a log and the other in leaf litter and stones in a small creek; near the summit of Mt. Hartley the animals (MCZ 112059-112060) were under granite boulders in an area of rocky outcrops and under debris on the forest floor, and at Speewah a single specimen (MCZ 128634) was found under a decayed log.

Dr H. G. Cogger has collected four specimens of *fuscicaudis*. One (A.M. R 29539) was out on a downed rotting log in the late afternoon in the moist closed forest around Lake Barrine. The other three (A.M. R 56561-56562, 57131) were under rotting logs in the wet mesophyll vine forest on the south side of Thornton Peak. This last locality is site number 42 in the Australian Museum and Queensland Museum's joint faunal survey of eastern Australian rainforests (Broadbent and Clark, eds., 1976).

I have collected three specimens, all from man-made clearings in rainforest: two (A.M. R 60772-60773) from under logs in a grassy clearing with a well developed second growth that had once been a loading area for logging trucks and the other (A.M. R 60774) from under a log in a very open, almost meadow-like clearing that had apparently once been part of a homestead.

Taken as a whole these observations indicate that while *fuscicaudis* is strongly associated with rainforest and often occurs well inside moist rainforest, it is also commonly found in open grassy areas within this habitat.

REPRODUCTION. There are four gravid females among the available specimens which give insight into the time and mode of reproduction. Two females contain large yolky ovarian eggs. One of these females (A.M. R 30359) was collected at Danbulla State Forest on 30 August 1970 and contains four eggs. The second female (Q.M. J 25412) was collected on the slopes of Mt. Hartley on 30 October 1974 and contains two eggs. These two females measure 90 and 60 mm SVL, respectively. The other two females contain oviducal eggs that have thick opaque shells which indicate that the species is oviparous. One of these females is the holotype (Q.M. J 25218) which was collected on the top of Mt. Finnigan on 9 November 1974; it measures 86 mm SVL and contains four eggs. The other female (Q.M. J 25135) was collected in Mt. Finnigan National Park on 10 November 1974; it measures 72 mm SVL and contains four eggs.

RELATIONSHIPS. *Sphenomorphus fuscicaudis* and *S. nigricaudis* are so similar in size, limb proportions, squamation and colour pattern, there can be little doubt that they are

indeed closely related. It is true that each species occurs in certain habitats not occupied by the other, e.g., *fuscicaudis* in moist rainforest and *nigricaudis* in savanna woodland, but these habitats are bridged by the open grasslands in rainforest sometimes occupied by *fuscicaudis* and by the monsoon rainforests sometimes occupied by *nigricaudis*. Although the evidence for the close relationship between *fuscicaudis* and *nigricaudis* seems fairly clear, there are as yet no characters recognizable on which to base an inference as to the phylogenetic polarity of this relationship.

A second species that probably has a fairly close relationship with *fuscicaudis* is *mjobergi*, an attenuate, short-limbed endemic of the rainforests of the Atherton Tableland. In addition to sharing similar body size, generally reduced limb proportions (Table 1) and habitat with *fuscicaudis*, it also has a series of cream coloured blotches in the dorsolateral line similar to this species (see Plate IV in Greer and Parker 1974). It differs, however, in several scale characters, most notably in generally having the fourth supralabial directly below the centre of the eye (Table 1). This is probably an advanced character in lygosomines in that the fifth supralabial is directly below the centre of the eye in most of the most primitive lygosomine taxa, e.g., *Mabuya*, as well as in most *Sphenomorphus* (pers. obs.). This character, plus the proportionately smaller limbs of *mjobergi* (Table 1), suggest that *fuscicaudis* may be the primitive and *mjobergi* the derived taxon.

Curiously, the dorsolateral series of cream coloured blotches also serves to align both *fuscicaudis* and *mjobergi* with another endemic of the Atherton rainforests — the rare *Sphenomorphus tigrinum*. Whether this similarity is due to close relationship or convergence is uncertain, however. The fact that these three geographically proximate species are the only Australian *Sphenomorphus* with a series of light cream coloured spots in the dorsolateral line might be taken to suggest that they are closely related. On the other hand, *tigrinum*'s relatively long limbs (Table 1), which are probably a reflection of its arboreal habits if unconfirmed field observations are true (Mr P. R. Rankin, pers. comm.), set it apart from the short-legged and terrestrial *fuscicaudis* and *mjobergi*. This suggests perhaps even more strongly that the colour patterns are convergent in the two groups. At the very least, a geographically proximate species with leg length intermediate between *tigrinum* on the one hand and *fuscicaudis* - *mjobergi* on the other would seem to be required to give credence to the notion that the colour pattern of the dorsolateral area alone is a true indication of a distinct lineage of north Queensland rainforest skinks. It seems much more likely, in fact, that the relationships of *tigrinum* are closer to *tenuis*, a species which it resembles in limb length and arboreality, as well as in body size and squamation (Table 1 and Mr P. R. Rankin, pers. comm).

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I am especially indebted to the late Mr P. R. Rankin for sharing his morphological data on *Sphenomorphus tenuis* with me and to Mr Fred Parker for making his field notes on both *S. fuscicaudis* and *S. nigricaudis* available.

I am also grateful to Dr H. G. Cogger for supplying the photographs for the paper and to Ms P. Greer for producing the drawings and map.

Dr H. G. Cogger, Mr H. F. W. Ehmann, Ms P. Greer and Mr P. R. Rankin provided critical readings of the manuscript.

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Table 1. A comparison of certain characters between *Sphenomorphus fuscicaudis* and four of its similar Australian relatives.

Character	<i>fuscicaudis</i>	<i>nigricaudis</i>	<i>mjobergi</i>	<i>tenuis</i>	<i>tigrinum</i>
Midbody Scale Rows					
Range	27-30	24-30	22-24	27-38	28-32
Mean	28	26.9	22.4	29.6	30.1
Mode	28	28	22	30	30
N	35	52	11	288	15
Paravertebral Scales					
Range	60-70	52-58	66-73	59-73	64-68
Mean	65.1	55.8	69.2	65.5	66.2
S.D.	2.71	1.34	2.71	3.65	1.81
N	36	28	6	30	10
Subdigital Lamellae					
Range	19-24	16-23	12-15	17-26	22-27
Mean	20.9	19.1	13.6	21.7	24.8
S.D.	1.33	1.52	1.13	1.85	1.90
N	36	59	11	291	12
Prefrontals					
Separated	.97	1.00	1.00	.90	.07
Meet	.03	—	—	.10	.93
N	35	61	11	62	14
Supraciliaries					
Range	7-9	7-9	7-8	7-9	8-9
Mode	8	8	7	8	9
N	36	55	11	50	15
Supraocular Scale					
Below Centre of Eye					
6th	—	.03	—	.02	.07
5th	.97	.95	.18	.97	.93
4th	.03	.02	.82	.01	—
N	36	62	11	197	15
Nuchal Scales					
Range	1-4	3-5	3-4	1-4	0-4
Mode	2	4	3	3	1
N	36	60	11	55	15
Snout-vent length (mm)					
Range	42-91	31-91	40-91	28-87	57-84
N	36	65	11	412	15
Front leg/ snout-vent length					
Range	.18-.23	.18-.24	.13-.16	.24-.32	.28-.33
N	29	18	6	21	7
Rear leg/ snout-vent length					
Range	.28-.37	.28-.35	.19-.24	.34-.44	.41-.47
N	29	17	6	21	7
Tail length/ snout-vent length					
Range	1.48-1.76	1.51-1.76	1.50-1.94	1.15-1.64	1.47
N	7	11	5	99	1
Mode of reproduction	oviparous	oviparous	?	viviparous	?

A NEW SPECIES OF *LERISTA* (LACERTILIA: SCINCIDAE) FROM NORTHERN QUEENSLAND, WITH REMARKS ON THE ORIGIN OF THE GENUS

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With 34 described species (Cogger 1975), *Lerista* is the second largest genus of lizards in Australia, and like the largest genus — the scincid genus *Ctenotus* with 53 described species — it is widespread in the arid, semi-arid and seasonally dry parts of the continent. In contrast to the large, surface dwelling species of *Ctenotus*, however, the species of *Lerista* are small, attenuate forms with reduced or non-existent limbs and cryptozoic to fossorial habits.

As a result of the painstaking work of Dr Glen Storr of the Western Australian Museum, the alpha taxonomy of both genera in the western half of the continent is well known. In the eastern half, however, the alpha taxonomy of the two genera is still poorly known and several species await description in both groups. Both taxa are important to our understanding of how lizards have evolved in the vast arid regions of Australia (see for example Pianka's [1972] use of *Ctenotus* in his zoogeographical analysis of Australian desert lizards), and a sound and complete taxonomy of the two groups is therefore greatly to be desired.

The purpose of this paper is to describe a new species of *Lerista* from northern Queensland that is unusual in being legless and to comment on the origin of the genus.

***Lerista ameles* n.sp.**

(Fig. 1)

HOLYOTYPE. Queensland Museum J 30004. Collected 19.7 km west of the junction of the Kennedy and Gulf Highways along the Gulf Highway, northeastern Queensland on 22 June 1977 by Allen E. Greer. This specimen was formerly A.M. R 63192.

DIAGNOSIS. *Lerista ameles* and the recently described *apoda* (Storr 1976) are the only species of *Lerista* that are limbless. *L. ameles* differs most noticeably from *apoda* in having the eye well developed but small and protected by a movable lower eyelid instead of vestigial below a fixed head scale; the frontoparietals and interparietal distinct instead of fused into a single scale, and the snout bluntly rounded in lateral view instead of wedge-shaped.

DESCRIPTION. In general appearance *ameles* is a small, limbless skink of nearly uniform dark but slightly shiny coloration.

Rostral wider than long, with an acute posteriorly projecting medial apex; nasals very large, in broad medial contact; nostril placed well forward in nasal; supralabials five, first much the largest, third below centre of eye; frontonasal much wider than long; prefrontals widely separated; loreals two; frontal about as wide as long; supraoculars two, first in contact with frontal; supraciliaries two, first projecting in front of first supraocular and

second projecting behind; lower eyelid movable, with a transparent window; frontoparietals distinct, just barely touching medially; interparietal distinct, much larger than either frontoparietal, with a parietal eye spot located just posterior of centre; parietals in broad contact behind interparietal, each bordered on its posterolateral edge by the anterior nuchal and the very large upper secondary temporal; two pairs of transversely enlarged nuchals; external ear opening small but distinct; infralabials four; mental only slightly wider than long; postmental wider than long, in contact with only first infralabial and followed by two lateral and one medial chin scales.

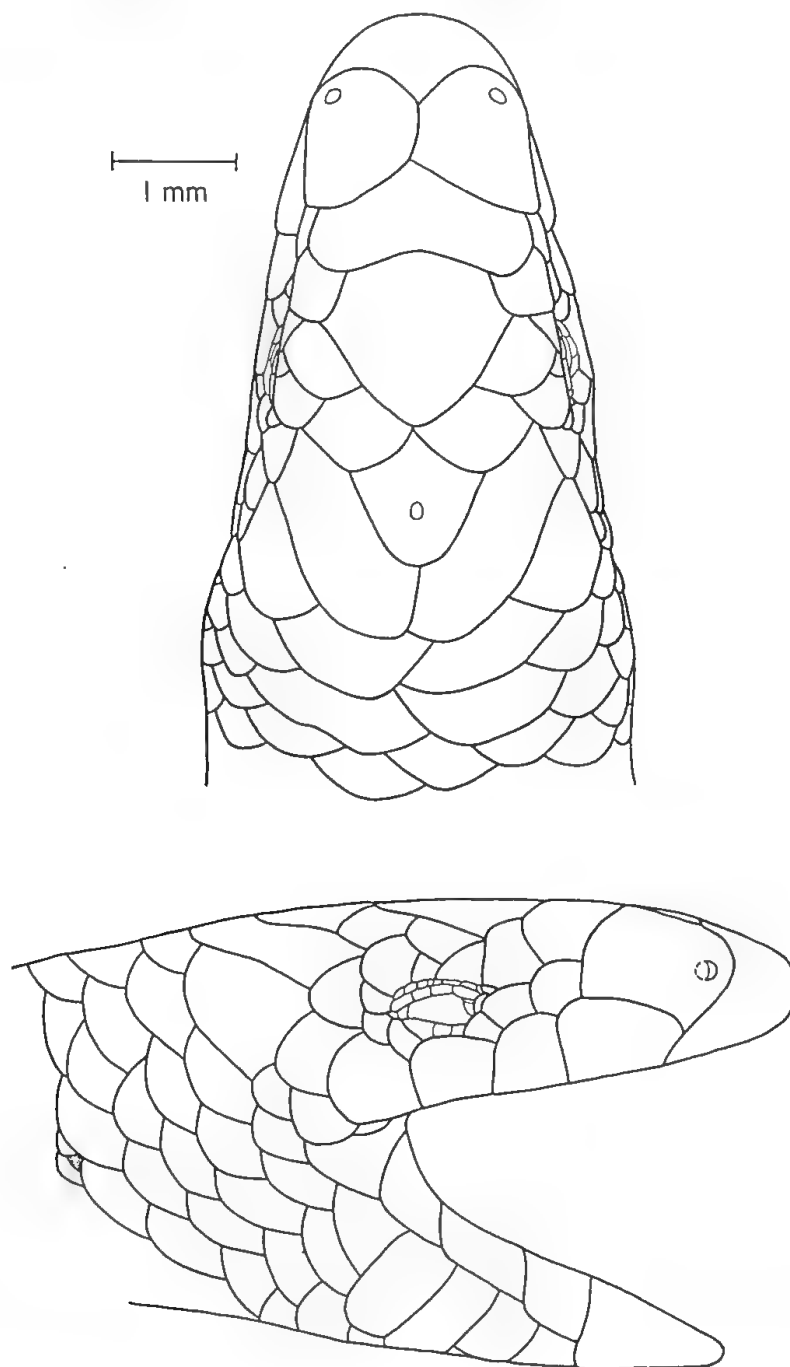


Fig. 1. Top and lateral view of the head of the holotype of *Lerista ameles* (Q.M. J 30004).

Body scales smooth, in 18 longitudinal rows at midbody; medial pair of preanals much larger than neighbouring scales; medial subcaudals equal in size to more lateral subcaudals.

Snout-vent length = 58 mm; unregenerated section of tail = 52 mm, regenerated section = 1.5 mm; limbs totally lacking but a slight depression just anterolateral to the vent probably indicates the former position of the rear legs.

Dorsum dark silvery grey with a slightly darker longitudinal stripe through each of the six most dorsal rows; sides and venter dark brown (hence sides and venter darker than dorsum). Rostral, nasal, first supralabial, mental and first infralabial with the slightly thickened epidermis and greyish suffusion typical of many burrowing skinks.

ETYMOLOGY. The name of the species derives from the Greek roots for "without" (*a*) and "legs" (*melos*).

DISTRIBUTION. The species is known to date only from the type locality which is approximately 33 km east of Mt. Surprise along the Gulf Highway.



Fig. 2. Map showing the type and only known locality for *Lerista ameles*.

HABITAT. The only known specimen of *ameles* was collected from under a large rock lying in a shallow, soil-filled depression on the top of a low sparsely vegetated granite outcrop. The outcrop was surrounded by the weathering olivine basalt of the McBride Plateau which is centred to the ESE of the type locality. The basalt field carries a medium height open *Eucalyptus* woodland savanna (eM₂G of Carnahan 1976) whereas the granite outcrop carries a distinctive vegetation of scattered low trees, shrubs and vines.

Although the single specimen of *ameles* came from the light coloured granite outcrop, the species' generally dark colour may in fact be a case of substrate matching with the more extensive surrounding basalt fields.

The Origin of the Genus *Lerista*

The most structurally primitive species of *Lerista* living today is undoubtedly *microtis* (Storr 1971), a species which is distributed along the coast of southcentral and southwestern Australia. The characters that mark this species as primitive are as follows; fore and rear limbs present and pentadactyl; lower eyelid movable; nasals separated medially (some individuals); prefrontals present; loreals two; supraoculars four, first two in contact with frontal; supraciliaries present, and frontoparietals and interparietal distinct (Greer 1974).

Another feature which marks *microtis* as primitive is the linear contact between the supraciliaries and supraoculars. This is in contrast to the zig zag contact due to the interdigitation of the supraciliaries and supraoculars evident in all other *Lerista* that retain supraciliaries (e.g., Fig. 1). A linear contact between the supraciliaries and supraoculars is probably primitive for lygosomines in that it is by far the most common pattern in the group and it occurs in all of the more generally primitive taxa, e.g., *Mabuya*.

There is only one aspect of the biology of *microtis* that is clearly derived within the genus *Lerista*, and that is its viviparity (Greer 1967). Most other *Lerista* as far as is known are oviparous, and this is almost certainly the primitive mode of reproduction for the genus. Hence in order to envisage a reasonable hypothetical common ancestor for all living *Lerista*, one may think of an oviparous *microtis*-like form.

The attenuate body, relatively short legs and very distinct dark lateral stripe of this hypothetical ancestor makes it very similar to a small group of *Sphenomorphus* in northern Australia (*crassicaudus*, *darwiniensis*, *pumilus* and an undescribed species from just west of the Atherton Tableland) and southern New Guinea (*crassicaudus* and *fragilis*). The species in this group are all members of the *fasciatus* species group of *Sphenomorphus* (Greer and Parker 1967 and 1974) and may be called the *crassicaudus* subgroup.¹

The similarities outlined above between the hypothetical ancestor of *Lerista* and the *crassicaudus* subgroup suggest that the two groups may have shared a common ancestor. If this is true, *Lerista* could be considered to be the more derived group due to the fact that it shows at least four unequivocally derived character states *vis-a-vis* the *crassicaudus* subgroup, i.e., seven instead of nine premaxillary teeth; nasals extending toward the midline instead of being more widely separated; a clear window in the lower eyelid instead of a scaly lower eyelid, and the supradigital scales in a single row throughout the length of

1. In an earlier paper I attempted to divide the *fasciatus* group into two subgroups based on the presence or absence of the ectopterygoid process — a process extending anteriorly from the ectopterygoid bone to the palatine along the anterolateral edge of the pterygoid (see Fig. 1 A-C in Greer 1967 and Plate 1 in Greer and Parker 1974). However, a continuing inability to find other characters supporting this subdivision has caused me to lose confidence in the ectopterygoid process as anything more than a convenient discriminatory character (Greer and Parker 1974). In this paper I begin to look for new ways to subdivide the *fasciatus* species group.

the digit instead of in multiple rows at least basally (Greer 1974 and 1979), whereas the *crassicaudus* subgroup shows only one obvious derived character state *vis-a-vis* the hypothetical ancestor of *Lerista*, i.e., the front and hind legs are relatively shorter (per. obs.).

Lerista also differs from certain members of the *crassicaudus* subgroup in two other characters, but variation in both characters in the *crassicaudus* subgroup and no precise knowledge of *Lerista*'s relationships within this group make it difficult to determine if the character states in *Lerista* are primitive or derived. *Lerista*, for example, lacks a postorbital bone, which is certainly a derived character in the subfamily of which *Lerista* is a member, i.e., the Lygosominae (Greer 1974), but the fact that this bone is also lacking in all species of the *crassicaudus* subgroup except *fragilis* makes it quite possible that the absence of the postorbital in *Lerista* is primitive. *Lerista* also has an ectopterygoid process, which is probably a derived character in lygosomines if its general absence in other structurally primitive lygosomine genera such as *Mabuya* is a guide, but the fact that the process is present in *fragilis* in the *crassicaudus* subgroup raises the possibility that the process is primitive in *Lerista*. As the relationships of *Lerista* within the *crassicaudus* subgroup become better known, the phylogenetic significance of the absent postorbital bone and the ectopterygoid process in *Lerista* should become clearer.

The fact that the members of the *crassicaudus* subgroup are restricted to tropical northern Australia and southern New Guinea whereas the most primitive species of *Lerista* is restricted to the temperate southwest coast suggests that a shift in physiological requirements may also have accompanied the morphological modifications leading to *Lerista*. The disjunct distribution poses no zoogeographic problem, however, for the endemic *Sphenomorphus gracilipes* of southern Australia shows that the *fasciatus* species group, which is now restricted to the north and east parts of Australia, once had a much wider distribution in the south.

Finally, it is interesting to note that despite the fact that many of the extreme morphological trends shown by many species of *Lerista* are almost certainly adaptations to burrowing, e.g., a reduction and loss of digits and limbs, a countersinking of the lower jaw, a reduction in eye size, a fusion and loss of head scales, and the development of ventrolateral ridges in at least one species (*planiventralis*), there is one feature that, although susceptible to loss in other burrowing groups, has been surprisingly little modified in *Lerista*. This is the external ear opening. In all *Lerista*, including the two limbless forms — *apoda* and *ameles* — the external ear opening is small but persistent. This implies that despite the other "concessions" made by *Lerista* to a burrowing existence, the traditional surface adapted auditory mechanisms may have been largely retained.

ACKNOWLEDGEMENTS

The Queensland National Parks and Wildlife Service provided the permits under which the type of *Lerista ameles* was collected.

Dr Harold G. Cogger, Ms Phlyp Greer and the late Mr Peter R. Rankin read drafts of the manuscript and made useful comments.

Ms Phlyp Greer provided the drawing for Fig. 1.

The Australian-American Educational Foundation, Canberra, A.C.T. provided financial support for the author's studies on Australian skinks.

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RECORDS OF THE AUSTRALIAN MUSEUM

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PAPERS FROM THE
LIZARD ISLAND MALACOLOGICAL WORKSHOP,
DECEMBER, 1975

PART 1
THE BIOLOGY AND FUNCTIONAL MORPHOLOGY
OF THE CORAL-SAND BIVALVE
FIMBRIA FIMBRIATA (LINNAEUS 1758)

B. MORTON

NOTES ON TWO SPECIES OF RHYTIDID SNAILS
FROM LIZARD ISLAND, NORTH QUEENSLAND

B. J. SMITH

A REVISION OF QUEENSLAND LITHOPHAGINE
MUSSELS (BIVALVIA, MYTILIDAE, LITHOPHAGINAE)

B. R. WILSON



THE LIZARD ISLAND MALACOLOGICAL WORKSHOP

A Molluscan Workshop, with nine malacologists participating, was held on Lizard Island, Queensland during 1 to 12 of December, 1975.

The aim of the Workshop was to get together a small number of malacologists at the Lizard Island Research Station on the Great Barrier Reef. Each scientist undertook one or two projects, the results of which are to be published in a collected series of papers. This issue of the 'Records' contains the first of these papers.

The scientists in attendance were:

Dr J. B. Burch (then of The Australian Museum, now at the University of Michigan);

Mr R. Burn (Research Associate of the Australian Museum and Associate of the National Museum of Victoria);

Dr B. Morton (University of Hong Kong);

Dr W. F. Ponder (The Australian Museum);

Dr C. F. E. Roper (Museum of Natural History, Washington, D.C.);

Mrs S. M. Slack-Smith (Western Australian Museum);

Dr J. B. Smith (National Museum of Victoria);

Dr B. R. Wilson (Western Australian Museum);

Sir C. M. Yonge (University of Edinburgh);

The projects included a survey of the non-marine Mollusca (Burch and Smith), studies on opisthobranchs (Burn), bivalve functional morphology (Wilson, Slack-Smith, Morton and Yonge), cephalopods (Roper) and gastropod reproductive morphology (Ponder).

Lizard Island (Figure 1) is a continental island in the northern end of Australia's Great Barrier Reef (lat. 14°40'S, long. 145°28' E). It is predominantly composed of granite, is about 2 square miles in area and at its highest point is about 360 m. It lies 30 km off the coast and is 17 km from the outer barrier reefs.

The Research Station on Lizard Island is operated by the Australian Museum. The participants of the Workshop acknowledge the support given them by the then Director, Mr S. Domm.

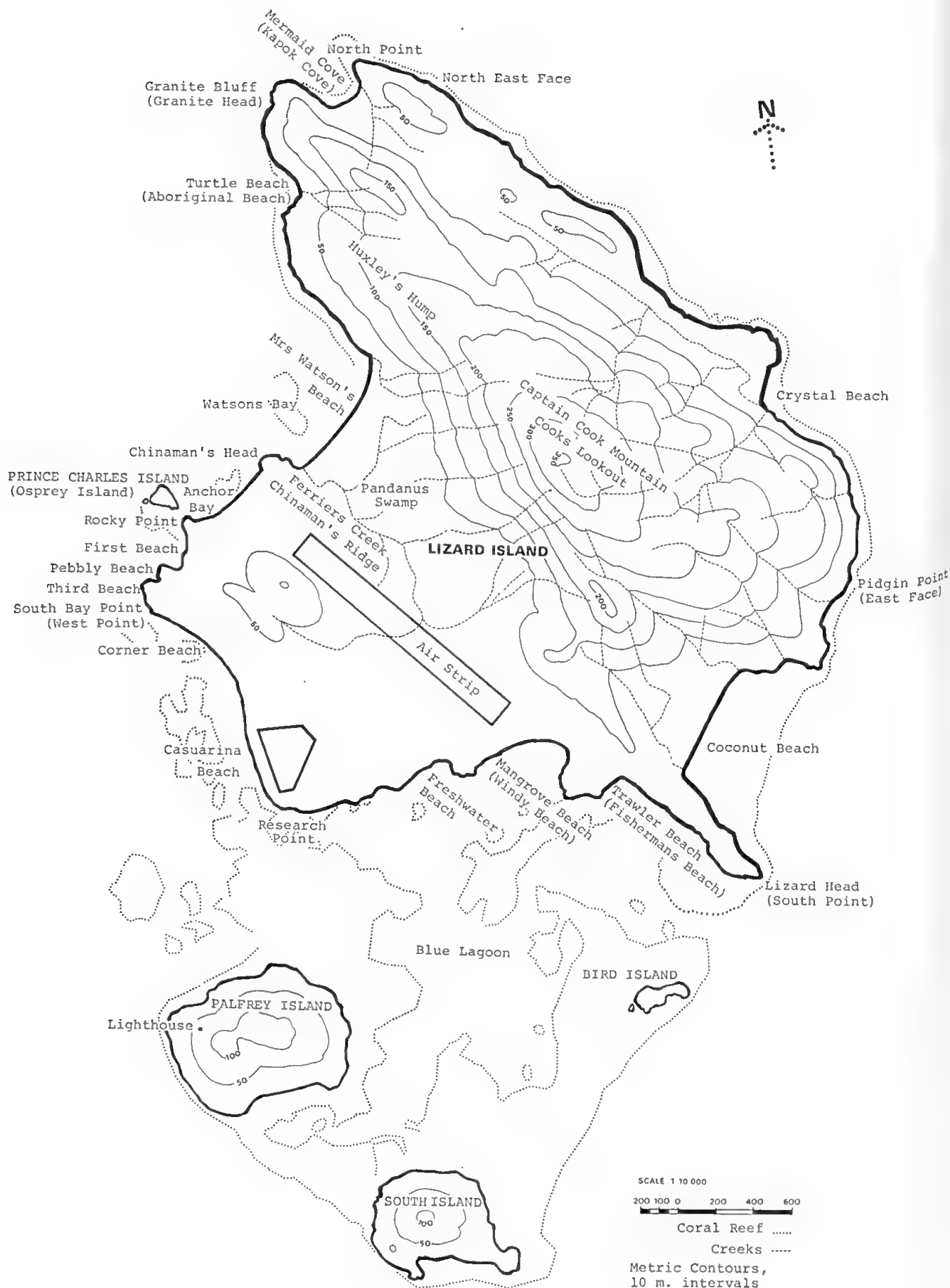
Mr P. H. Colman, Mr I. Loch, Ms B. Duckworth, Mr E. K. Yoo and Mrs M. Burch are also gratefully acknowledged for their able assistance with running and organizing the workshop.

One paper resulting from the workshop has been published elsewhere:

Morton, B., 1978. The diurnal rhythm and the processes of feeding and digestion in *Tridacna crocea* (Bivalvia: Tridacnidae). *J. Zool., Lond.*, 185: 371-387.

W. F. PONDER





THE BIOLOGY AND FUNCTIONAL MORPHOLOGY OF THE CORAL-SAND BIVALVE *FIMBRIA FIMBRIATA* (Linnaeus 1758)

BY BRIAN MORTON

Department of Zoology, The University of Hong Kong

SUMMARY



Fimbria fimbriata Linnaeus 1758 is an infaunal inhabitant of coral sands in the Indo-Pacific. The structure and mineralogy of the shell (Taylor, Kennedy and Hall, 1973) confirms its taxonomic position as a member of the Lucinacea. Nicol (1950) erected (giving no reasons) a new family, taking its name (the Fimbriidae) from the genus. This study supports the view of Allen and Turner (1970) and Boss (1970) that *Fimbria* is closely related to the Lucinidae Fleming 1828 though a study of fossil fimbriids will have to be undertaken before the extreme view of Allen and Turner (1970) that *Fimbria* is a lucinid, can be validated. The Lucinidae and *F. fimbriata* possess the following features in common.

1. An enlarged anterior half of the shell with an antero-dorsal inhalant stream.
2. A single (inner) demibranch with type G ciliation (Atkins, 1937b).
3. Reduced labial palps.
4. "Mantle palps".
5. A stomach closely similar in structure.
6. A unique method of withdrawing the posterior exhalant siphon.

The specialisations adapting *Fimbria* for a deposit feeding mode of life have also been elucidated and include:

1. Reduced ctenidia and labial palps.
2. The modification of the foot to form a food collecting organelle.
3. The development of "mantle palps".
4. Complex, efficient and complementary rejectory tracts on the visceral mass and inner mantle surface.
5. The copious production of mucus from all organs involved in the processing of potential food material.
6. Few sorting areas in the stomach.
7. Strong rejectory tracts in the stomach.
8. A small number of large apertures leading from the stomach to the digestive diverticula.
9. A short intestine.
10. An extensive pedal gape bordered by many sensory papillae.

The mode of life of *F. fimbriata* is described; the morphological features it possesses must be seen from two viewpoints. Primitive features give some support to the contention of McAlester (1966) that the Lucinacea are a phylogenetically old and quite distinct separate line of evolution in the Bivalvia. This study supports the view of Boss (1970), however, that the Lucinacea possess many typical heterodont characters and, though primitive, must be considered a significant component of the mainstream of eulamellibranch evolution.

Alternatively the specialisations of *F. fimbriata* suit it to life in nutrient deficient sediments and waters and are generally uniquely different to the solutions offered by other bivalves to similar modes of life.

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INTRODUCTION

Fimbria fimbriata (Linnaeus 1758), like many members of the Lucinacea (Allen, 1958) is an inhabitant of coral sands in the tropics. It has been little studied though both Valenciennes (1845a, b) and Thiele (1935) commented on various aspects of its anatomy. Later descriptions of the species are incomplete (Allen and Turner, 1970; Boss, 1970) because living material was unavailable. These examinations of preserved material left unanswered a wide range of questions with respect to the mode of life and the functional significance of the organs of the mantle cavity and alimentary canal. More importantly the relationships of *Fimbria* within the Lucinacea would benefit from a closer inspection of the living animal especially since Allen and Turner (1970) assert that it is a member of the Lucinidae and further question its present placement in, and the validity of, the Fimbriidae (Nicol, 1950).

This paper reports upon a study of living *Fimbria fimbriata*.

SYSTEMATICS

Fimbria fimbriata (Linnaeus 1758) is a member of the Fimbriidae Nicol 1950 one of six families of the Lucinacea Fleming 1828 recognised by Chavan (1969). In the Fimbriidae Chavan (1969) further recognises 9 genera of which only *Fimbria** Megerle von Mühlfeld 1811 (= *Corbis* Cuvier 1817) is extant. Synonyms of *F. fimbriata* (Linnaeus 1758) include *F. fimbriatum* Roeding 1798, *F. magna* Megerle von Mühlfeld 1811, *F. perforata* Schumacher 1817 (Cernohorsky, 1972). According to Nicol (1950) there are only two living species, both distributed in the Indo-Pacific.

A recent study of *Fimbria fimbriata* by Allen and Turner (1970) has suggested that this genus is more closely allied with the Lucinidae Fleming 1828 and contend that in the original description of the genus no reasons were given for the erection of the Fimbriidae by Nicol (1950). Boss (1969, 1970) accepted the view of Nicol, however, and wrote "Most probably a basic lucinoid stock gave rise to the distinct fimbriids which paralleled the lucinids. . . ." Not until further study has been undertaken of the fossil fimbriids,

* The nudibranchiate genus *Fimbria* Bohadsch 1761 (Taylor and Sohl, 1962) has been rejected by the I.C.Z.N. thereby invalidating the family name based on this genus.

however, will it be possible to decide on the validity of the Fimbriidae, but this study re-examines *F. fimbriata* and specifically compares it with members of the Lucinidae.

More importantly, McAlester (1965, 1966) has asserted that "This lineage (Lucinacea, Leptonacea and *Babinka*) should probably be treated as a separate bivalve taxon of the highest rank" that are "probably unrelated to most other "heterodont" forms". This view, refuted by Boss (1969), also bears further re-examination and in this context a detailed examination of *F. fimbriata* might well prove valuable.

BIOLOGY

The Lucinacea occur in a variety of substrates ranging from coarse sand to fine mud. They are particularly prevalent, however, in coral sands where the associated fauna is sparse. *Fimbria fimbriata* occurs in a similar habitat at a range of depths and was common in the coral sands of Lizard Island. The species is widely distributed in the Indo-Pacific and ranges from Hawaii to Tonga and from Indonesia to Australia. The distribution has been recorded by Nicol (1950) and subsequently by Cernohorsky (1972).

The animal lies, as suspected by Boss (1970), with the dorsal region of the swollen anterior portion of the shell upwards, just underneath the surface of the sand; the position

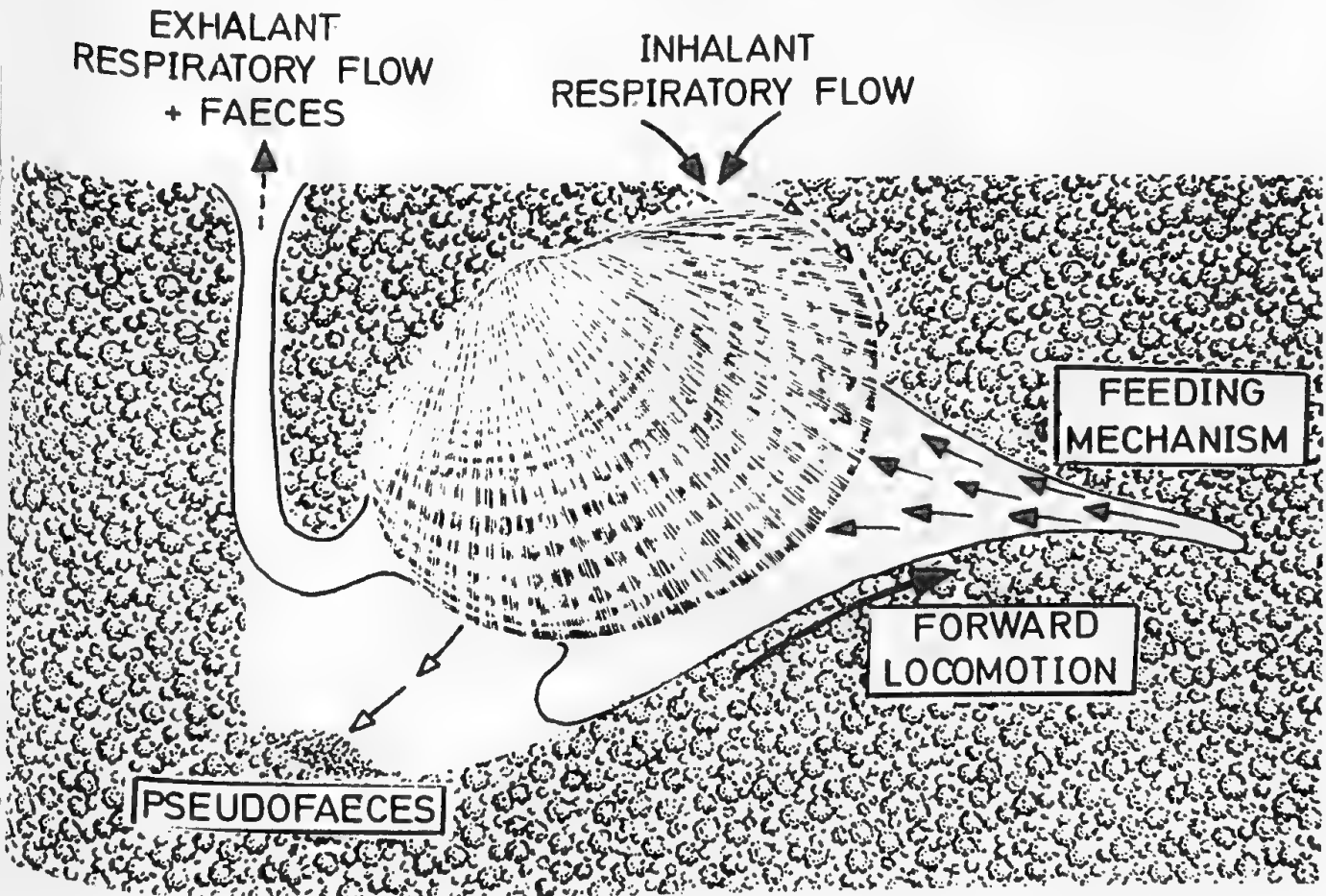


Fig. 1. *Fimbria fimbriata*. A diagrammatic representation of the living animal in its natural environment.

of the anterior inhalant aperture being marked by a shallow depression (Fig. 1). The posterior exhalant siphon was never observed extended; it possibly being quickly retracted when the animal was disturbed and also only periodically extended as the animal moved forward. *Fimbria* is, as suggested by Allen and Turner (1970), a slow mover; locomotion being the function of the foot, particularly the heel. The tip of the foot was seen to extend; the shell being pulled up after it presumably by contraction of the longitudinal muscles of the foot. The movement forward was also accompanied by a rapid adduction of the shell valves. Locomotion should best be compared with the description of this action in the leptonid *Mysella cuneata* by Gage (1968). The foot is also the food collecting organelle and does not, as it does in many lucinids (Allen, 1958; Allen and Turner, 1970), play any part in the construction of the anterior inhalant tube. There is no information on the rate of growth, population dynamics or reproduction in *Fimbria*; such subjects would be of considerable interest especially since, as will be explained later, *Fimbria* possibly incubates its larvae in the suprabranchial chamber. An un-named leptonid occurs around the inhalant aperture, typically attached to the periostracum.

THE SHELL AND LIGAMENT

The aragonitic shell of *Fimbria fimbriata* comprises (Taylor, Kennedy and Hall, 1973), as in all other lucinaceans, a complex crossed lamellar inner layer, a crossed lamellar middle layer, a composite prismatic outer layer and a thin prismatic pallial myostraca.

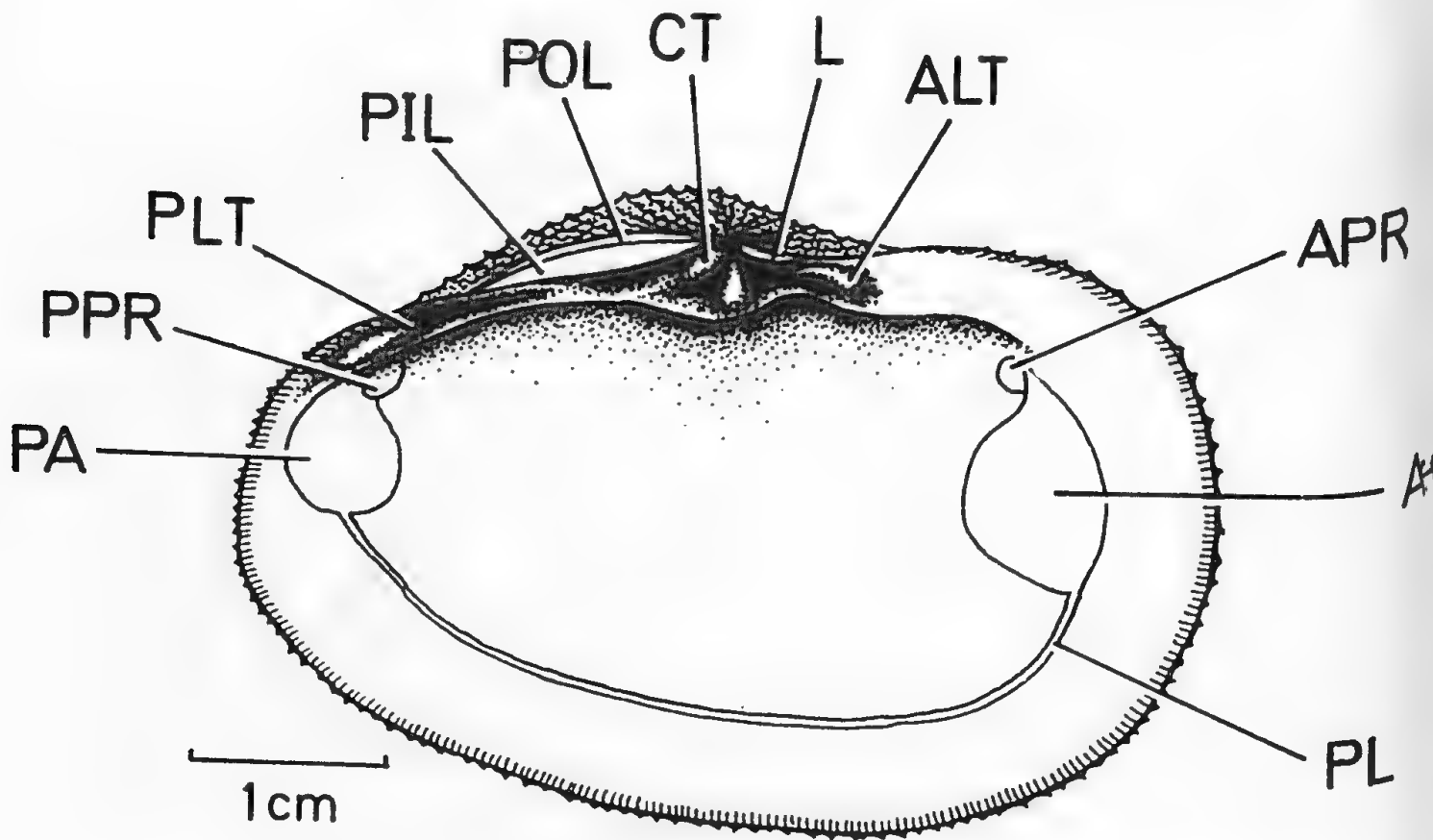


Fig. 2. *Fimbria fimbriata*. An internal view of the left shell valve. (For abbreviations see page 419.)

The shell of *F. fimbriata* is thick, equi-valve, but distinctly inequilateral (Fig. 2). The anterior half of the shell is more swollen than the posterior which is unusual especially since the ligament is opisthodetic. The umbones point anteriorly and there is a well defined heart-shaped lunule (Fig. 4A). Externally the shell is white changing hue to a delicate pink antero- and posterodorsally. The shell sculpture is reticulate, there being well defined concentric cords forming projections dorsally and feeble radial striae. The concentric cords form overlapping plates anteriorly and posteriorly.

Internally the hinge plate (Fig. 3) possesses in each valve two cardinal teeth (CT) and two lateral teeth — anterior (ALT) and posterior (PLT). The anterior lateral tooth is located under the lunule (L) while the posterior lateral tooth is located at the posterior extremity of the hinge plate. The margins of the shell valves meet at all points and prominent denticles on both valves interlock making the shell extremely difficult to open. The internal margin of the shell is coloured pink, the remainder of the shell being white except underneath the hinge plate which is yellow. *F. fimbriata* is approximately isomyarian though the anterior adductor muscle scar (Fig. 2, AA) is slightly larger than the posterior (PA). The adductor muscles are flanked internally by small, dorsally located anterior (APR) and posterior pedal retractor muscle scars (PPR). The pallial line (PL) is entire and there is no pallial sinus — a feature which would indicate in other bivalves that there are no, or only short, siphons. However, as will be seen later the Lucinidae and *F. fimbriata* have evolved an unusual method of withdrawing their exhalant siphon (Allen, 1958). Boss (1970) notes that the pallial line is contiguous with the scar of the anterior (but not the posterior) adductor muscle — a feature, as will be discussed later, associated with the position of the anterior inhalant stream.

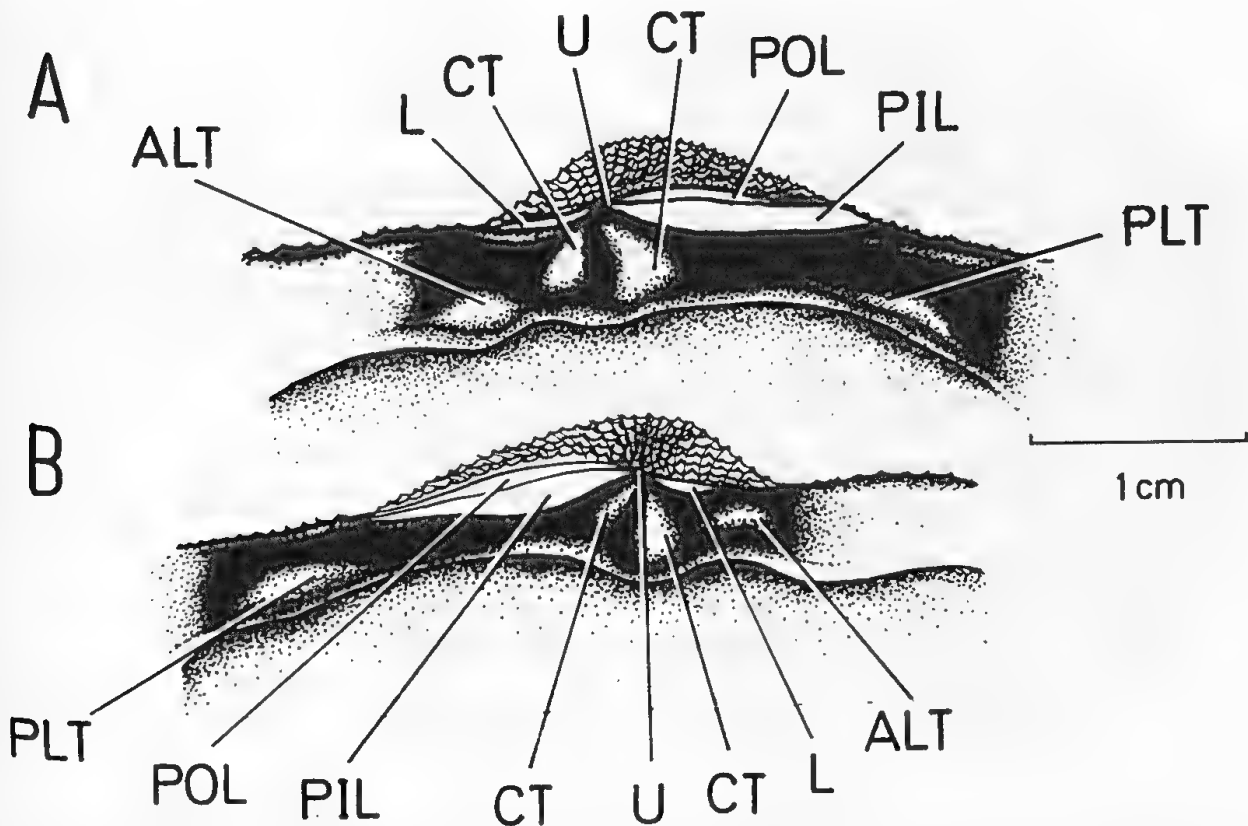


Fig. 3. *Fimbria fimbriata*. The hinge plate of (A), the right and (B), the left shell valves. (For abbreviations see page 419.)

The opisthodetic ligament of *F. fimbriata* (Fig. 3) has been described in detail by Allen and Turner (1970) who recognised that the ligament was covered, as is the lunule, by a layer of fused periostracum. Internal to this, posterior outer (POL) and inner ligament layers (IL) can be recognised, though Allen and Turner recognised a further fourth or "fusion layer" located between the periostracum and the posterior outer ligament layer. The structure of the mantle region that secretes the ligament has also been described in detail by Allen and Turner (1970).

The Mantle

The mantle comprises three folds as in all bivalves. Mantle fusions occur between the exhalant and inhalant siphons and between the inhalant siphon and the pedal gape. Dorsally the mantle forms the ligament, a process that has been explained for the Lucinacea (Allen, 1960) and for *Fimbria fimbriata* (Allen and Turner, 1970). Elsewhere mantle fusions are of the inner folds only and thus of type A (Yonge, 1957). Each mantle lobe possesses a double row of papillae — a feature noted by Thiele (1935), Allen and Turner (1970) and Boss (1970); those comprising the inner row are longer and are pointed inwards, those on the outer row are directed outwards. A similar double row of papillae also occur in the lucinid *Codakia orbicularis* (Allen and Turner, 1970).

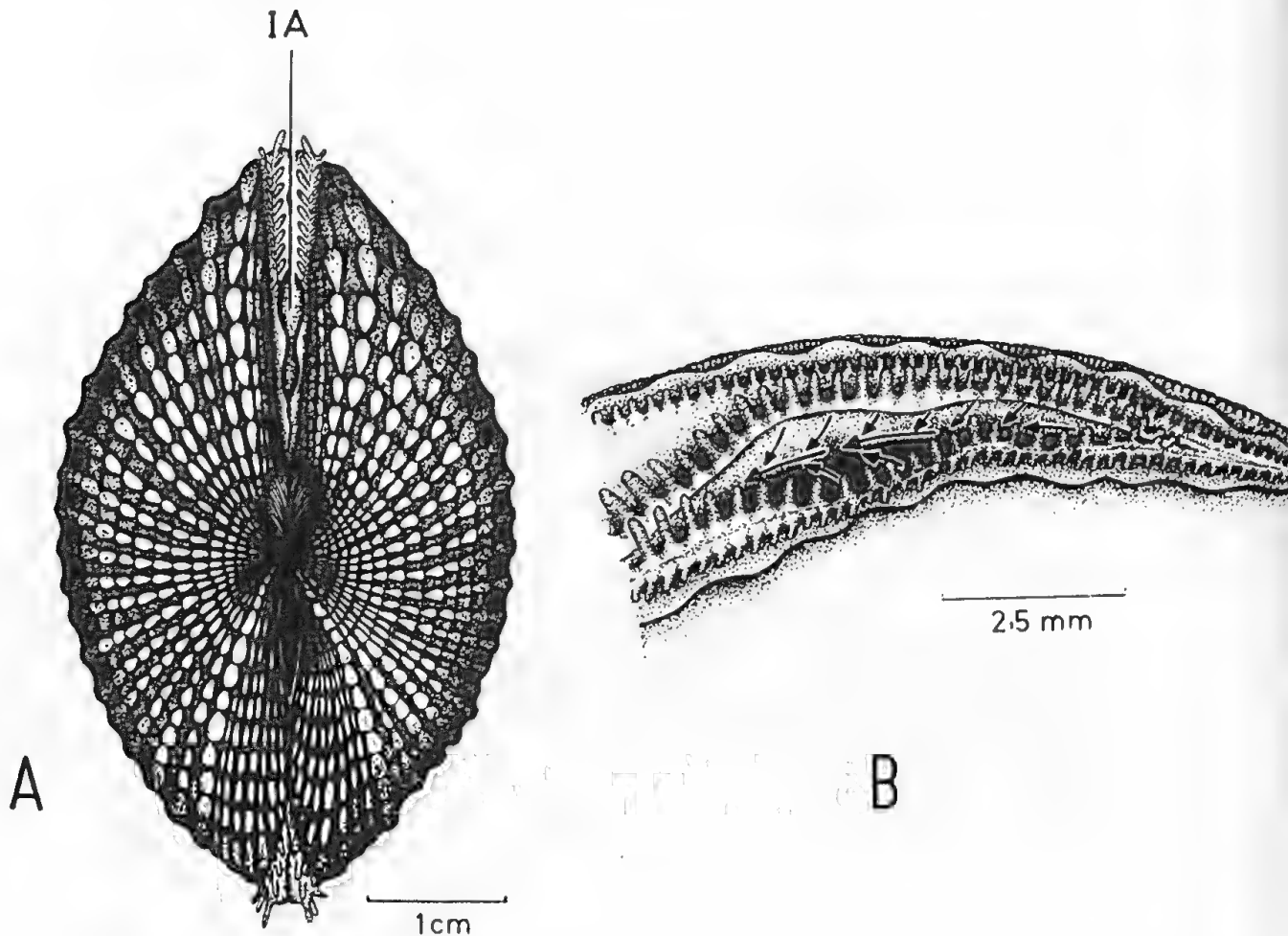


Fig. 4. *Fimbria fimbriata*. (A) A dorsal view of the shell with the inhalant aperture open. (B) A dorso-lateral view of the inhalant aperture. (For abbreviations see page 419.)

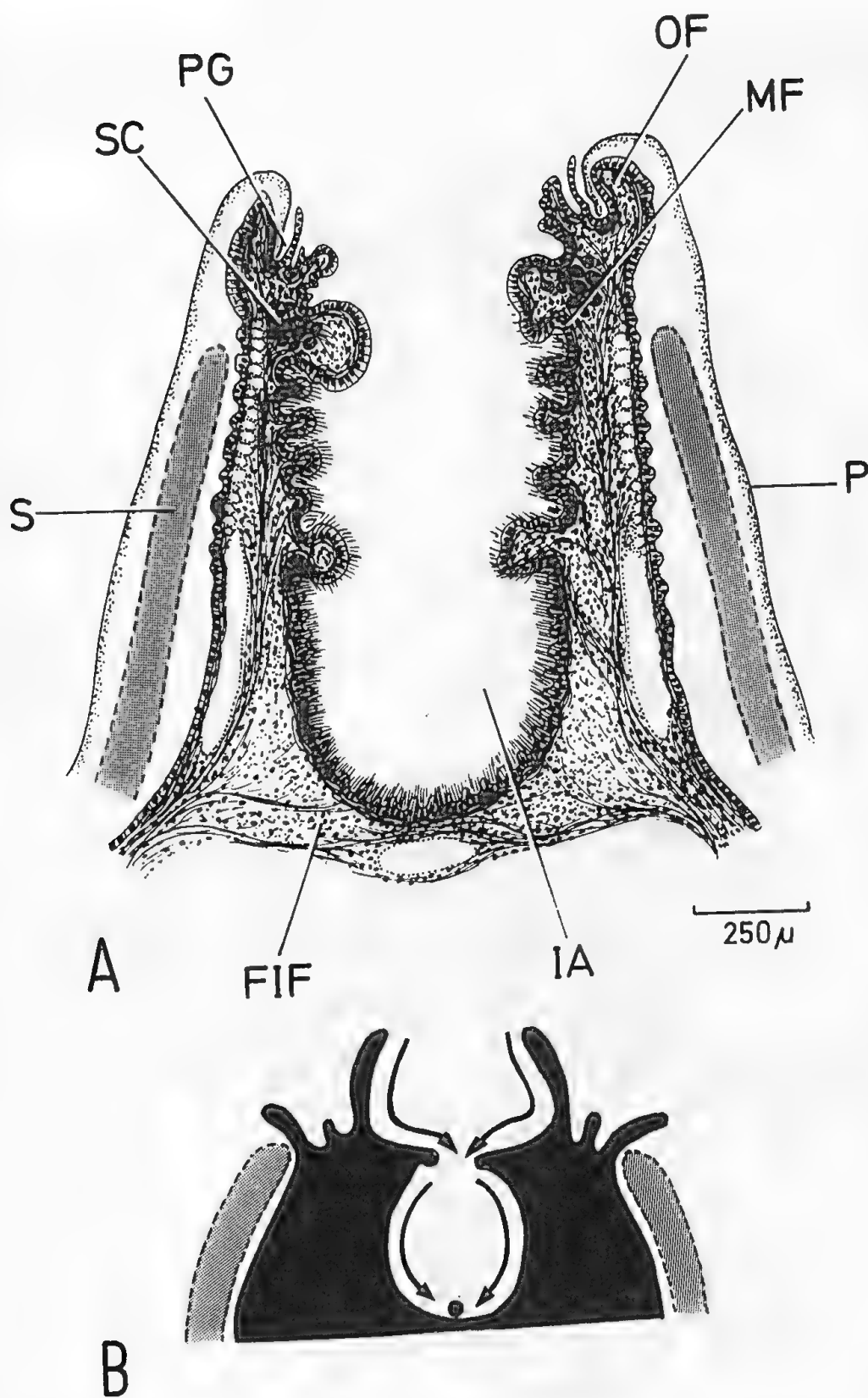


Fig. 5. *Fimbria fimbriata*. (A) A transverse section through the inhalant aperture. (B) A diagrammatic representation of a transverse section through the inhalant aperture showing the ciliary currents. (Closed circle = oral acceptance tract). (For abbreviations see page 419.)

The inhalant stream (Figs. 4 and 5) is located antero-dorsally. When specimens of *F. fimbriata* were positioned in a tank of sand through which fresh sea water flowed, a shallow depression was seen to be created by ciliary action on the outer surface of the middle fold of the antero-dorsal region of the mantle. The selective apposition of the middle folds of

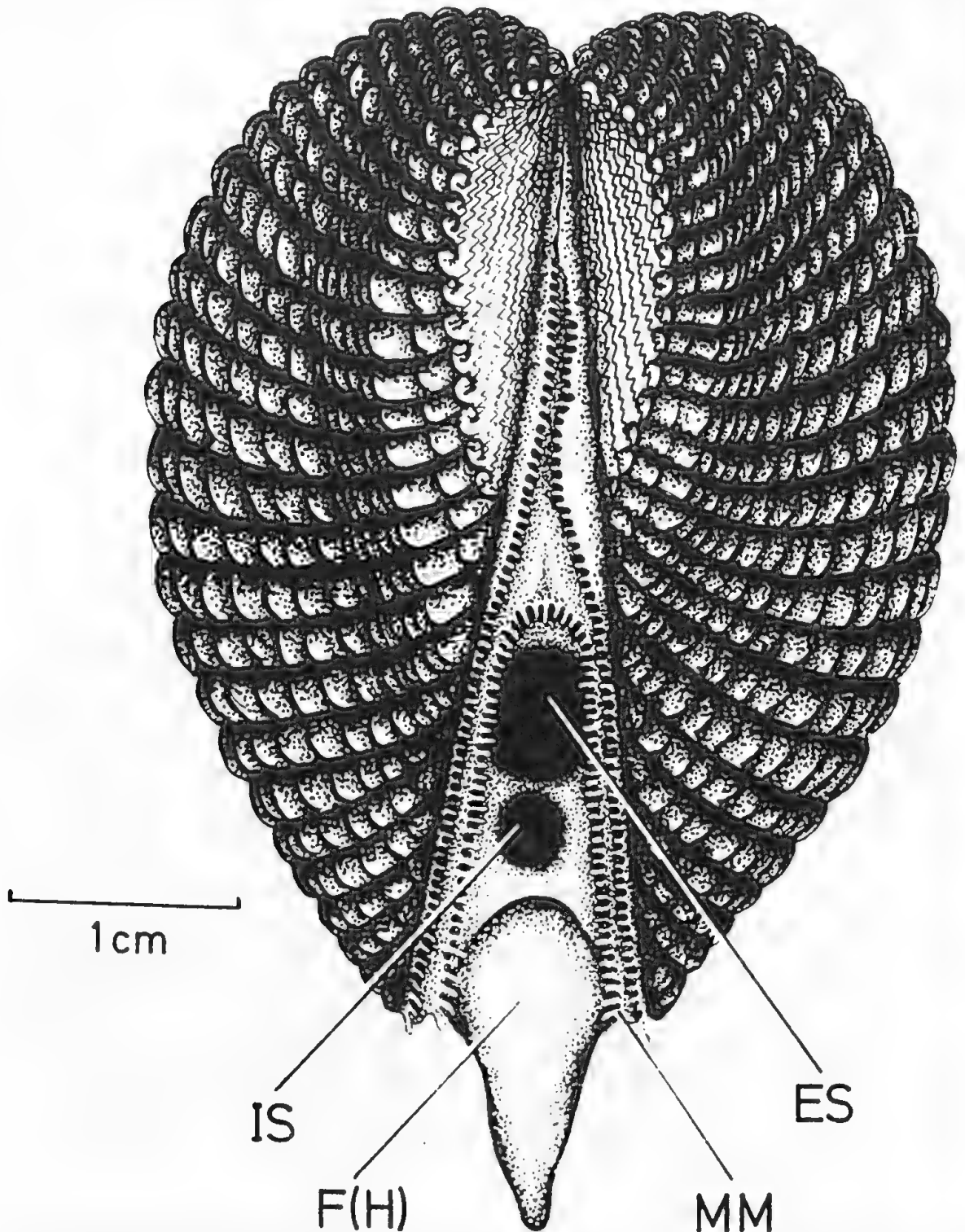


Fig. 6. *Fimbria fimbriata*. A posterior view of the shell showing the inhalant and exhalant siphons. (For abbreviations see page 419.)

both lobes creates a false inhalant "aperture" (IA) (false, since the inner folds are fused underneath) (Fig. 5). Boss (1970) was misled by this "false" aperture into believing that the mantle lobes were not fused. The aperture leads down to a groove formed by the outer surface of the fused inner mantle folds (FIF) and roofed over by the inner surface of the middle mantle fold (MF). Particles of carmine added to the groove were quickly transported antero-ventrally around the outside of the anterior adductor muscle and entered the mantle cavity ventral to the anterior adductor muscle via the pedal gape (Fig. 9). This explains the contiguous nature of the pallial line and anterior adductor muscle noted by Boss (1970) and the hypertrophy of the anterior half of the shell. The middle mantle fold can occlude the inhalant aperture without disturbing the sandy depression around it and the papillae surrounding the groove form a sensory defensive mesh. The foot of *F. fimbriata* unlike the foot of other members of the Lucinacea (Allen, 1958) plays no part, as will be discussed later, in the construction or maintenance of the inhalant aperture in the sand.

The short, rounded inhalant siphon (Fig. 6, IS) is located posteroventrally and is smaller than that of the exhalant siphon. Neither is crowned (as is typically the case in the Bivalvia) with tentacles. From this aperture pseudofaeces were occasionally expelled (Fig. 9, PS); this being undertaken by the rapid contraction of the shell valves.

The exhalant siphon (ES) is long and flared distally. The exhalant siphon alone is retractable within the supra-branchial chamber (Fig. 12C); by invagination. A similar mechanism of siphonal retraction is seen in members of the Lucinidae (Allen, 1958) and in *Myadora ovata* (Pelseneer, 1911) where in the latter case the inhalant siphon invaginates into the infrabranchial chamber. The exhalant stream is directed from the exhalant siphon in *Fimbria*.

The pedal gape is extensive and from between the separate mantle lobes is extended the long, subtrigonal foot.

The structure of the ventral margin of the mantle of *F. fimbriata* has been described by Allen and Turner (1970). This description (Fig. 7A) adds to the earlier account. The periostracum (P) secreted from within the periostracal groove, possibly from apical cells as in *Astarte* (Saleuddin, 1974), comprises a single layer 6 μ thick. In many other heterodonts the periostracum is two layered e.g. *Dreissena polymorpha*, *Galeomma polita* and *Geloina erosa* (Morton, 1969, 1973, 1976b), whereas in the Mytilacea it comprises three layers (Beedham, 1958; Morton, 1973a). As noted by Allen and Turner (1970), the mantle margin possesses two types of secretory cell (SC). In the inner mantle fold (Fig. 7B, IF) the secretory cells are epidermal and some 25 μ tall whereas in the middle mantle fold (Fig. 7C, MF) the secretory cells are sub-epidermal with channels passing between ciliated epithelial cells of reduced height (10-12 μ). The mantle possesses an extensive musculature (PM) and a concomitant large pallial line (PL) is seen on the shell. The mantle is thick with bands of muscles cross-connecting the two epithelia. A pallial blood vessel has been described by Allen and Turner (1970) and Boss (1970).

The ciliary currents of the mantle

The ciliary currents of the mantle are complex (Fig. 8). An anterior, oralward, current marks the line of attachment of the descending lamella of the inner demibranch to the mantle (FO) i.e. the ctenidial axis. Ventrally each mantle lobe possesses a posteriorly directed current that leads to the base of the inhalant siphon (IS). This current travels within a well defined ciliary groove in each mantle lobe and is supplied with material from the inwardly directed currents of the mantle edge. The general surface of each mantle lobe can be divided into two halves, anterior and posterior. In the anterior half, ciliary currents

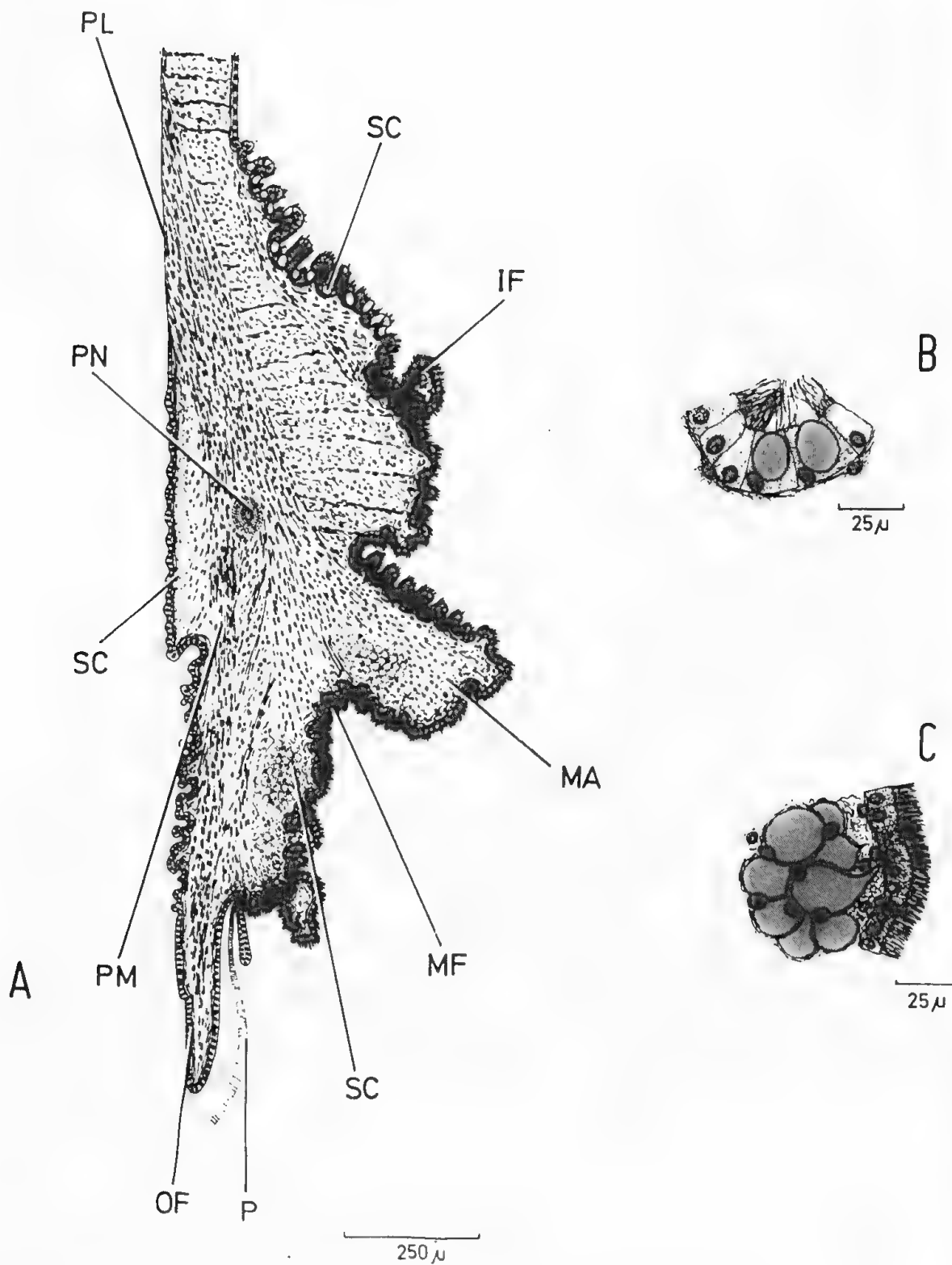


Fig. 7. *Fimbria fimbriata*. (A) A transverse section of the mantle margin in the region of the pedal gape. The secretory cells of (B) the inner mantle fold and (C) the middle mantle fold are also represented. (For abbreviations see page 419.)

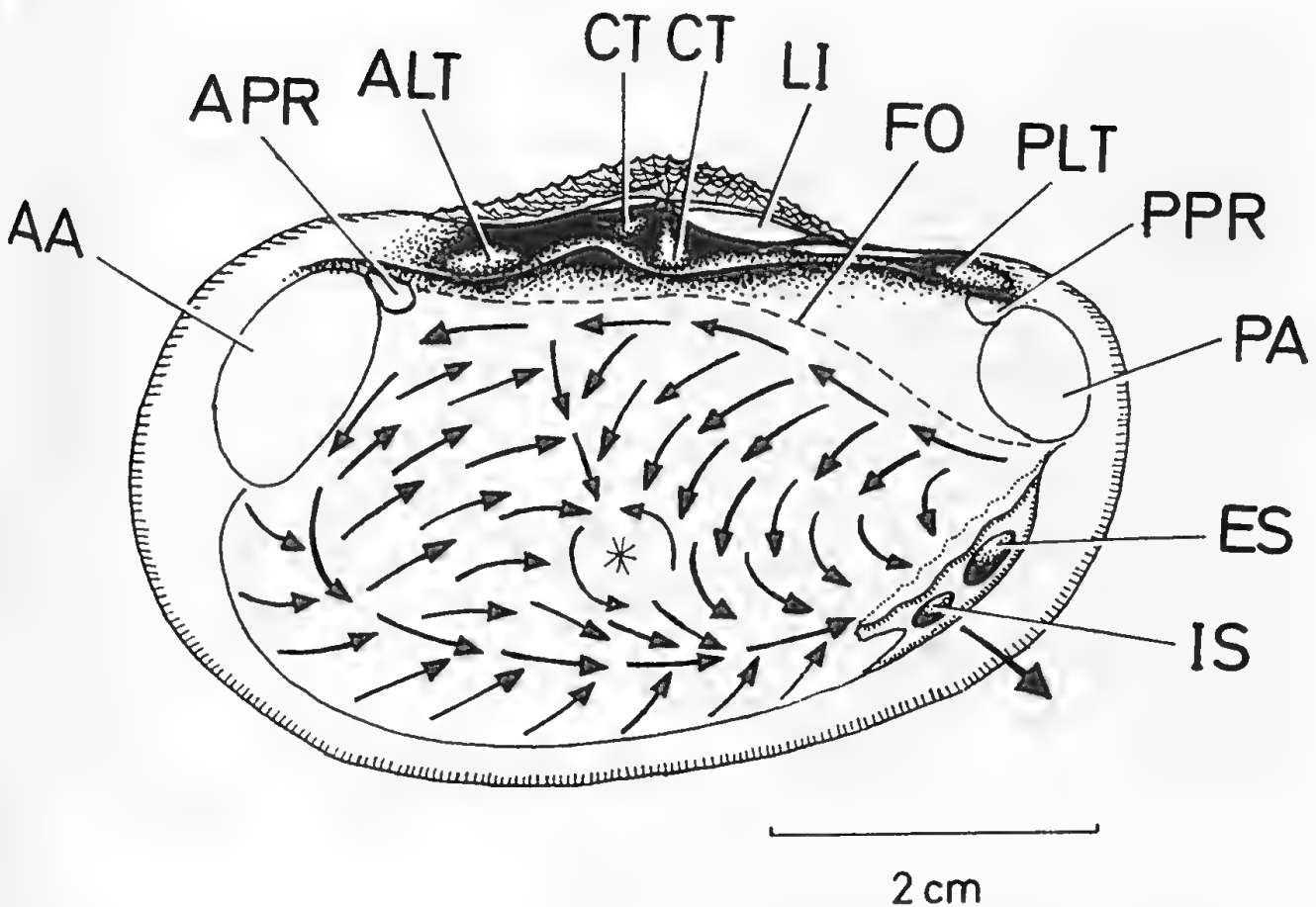


Fig. 8. *Fimbria fimbriata*. The ciliary currents of the right mantle lobe. (* = area of ciliary confluence). (For abbreviations see page 419.)

are directed posteriorly; in the posterior half, anteriorly. They meet in the mid line and create a ventrally directed ciliary tract that connects up the dorsal anterior tract and the ventral posterior tract. At the confluence of the latter ciliary tracts the conflicting ciliary currents set material in a circular anti-clockwise rotation on the right side and in a clockwise direction on the left side. The region of confluence on each mantle lobe has a partner on the visceral mass. These currents are more complex than those of the various lucinaceans described by Allen (1958).

The ctenidia

The ctenidia are homorhabdic, non plicate and eulamellibranchiate. Each comprises one demibranch — the inner, though Purchon (1939) considered it the outer. The ascending lamella is attached to the visceral mass anteriorly by ciliary fusion (Fig. 10A) as for example in various anomiid (Atkins, 1937a; Morton, 1976a). The interlocking cilia are some 8 long. Posteriorly the dorsal edges of the left and right ascending lamellae fuse behind the visceral mass by tissue fusion (Fig. 12C). For comparison the tissue fusion of the ctenidial axis is also figured (Fig. 10B).

The ciliary currents of both lamellae (Fig. 12B) beat ventrally towards a ventral marginal food groove which transports material orally. The ciliary currents are thus of type G (Atkins, 1937b) and similar currents are possessed by the Lucinidae, Montacutidae and Teredinidae. Material passing into the ventral marginal food groove is passed directly

between the palps and so to the mouth. In view of their smallness it is likely that particles arriving at the palps on the crests of the groove are similarly not selected against and also enter the mouth.

Oralward currents in the ctenidial axis and in the junction of the ascending lamella of the inner demibranch with the visceral mass are created by the mantle and the visceral mass respectively and not by the ctenidia.

Each ctenidial filament (Fig. 11A) typically comprises four apical cells possessing frontal cilia (FC) 8 long; these cilia create the ventral flow of particles. The apical cells are flanked on each side by one, but occasionally two cells with large nuclei, 10 in diameter. These cells possess the stiff, interlocking eulaterofrontal cilia (EFC) (12 long) which flick particles onto the frontal cilia. Laterally a pair of cells possess the lateral cilia (LC) which create the inhalant stream. These cilia are 12 long. The arrangement of the filament cilia is the same as in many other lucinids e.g. *Divaricella* and unguinids e.g. *Diplodonta*, but differs from thyasirids which also possess prolaterofrontal cilia (Allen, 1958). The filament is very long and is lined by large cells (GC) containing brown granular material. Similar cells are seen in the Lucinacea and Allen (1958) considered them excretory. Cords of these granular cells (Fig. 11B, GC) also line the inner, but not the outer, surface of the capacious supra-branchial chamber (SBC).

The labial palps

The labial palps (Fig. 13, ILP; OLP) are minute and comprise two triangular flaps of tissue delicately marked with three or four shallow ridges. They form extensions to the

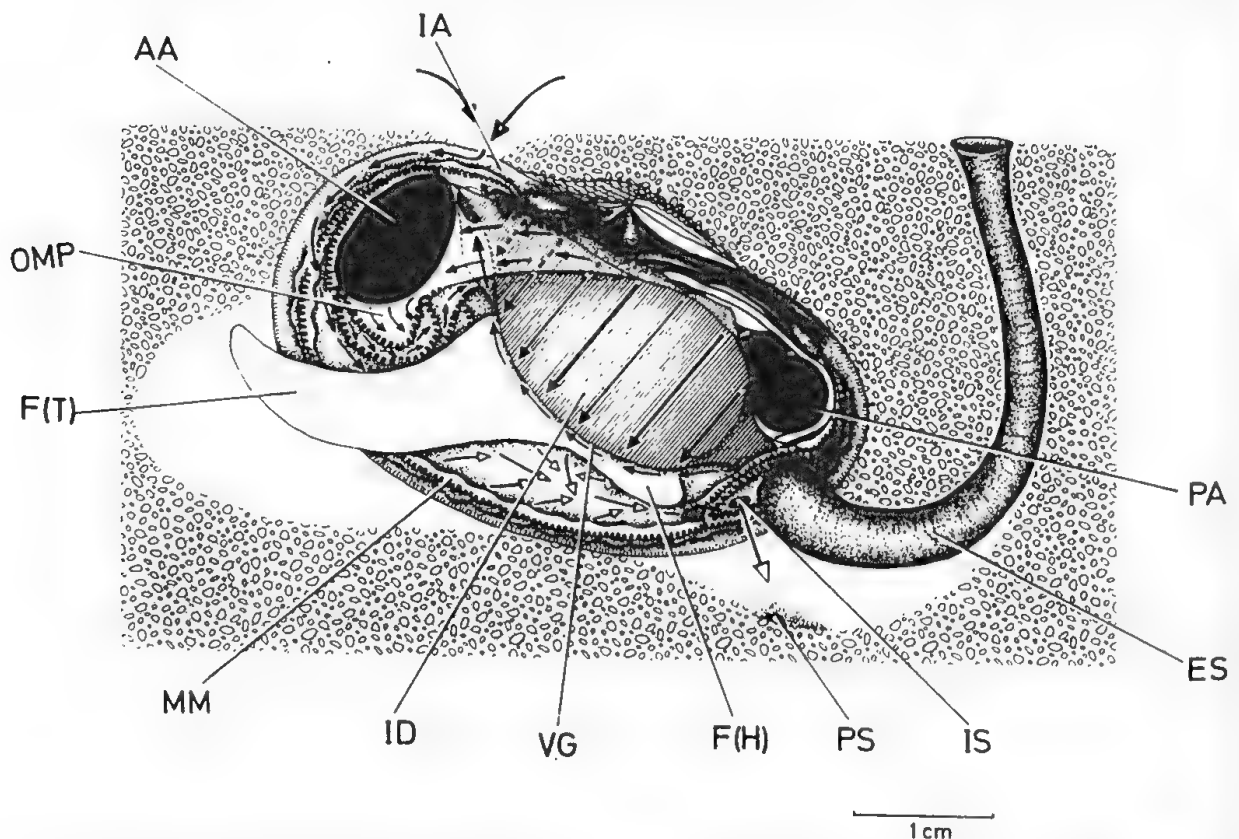


Fig. 9. *Fimbria fimbriata*. The ciliary currents of the mantle cavity after removal of the left shell valve and mantle lobe. The animal is lying in its natural position in the sand. (Closed arrows, acceptance tracts; open arrows, rejectory tracts). (For abbreviations see page 419.)

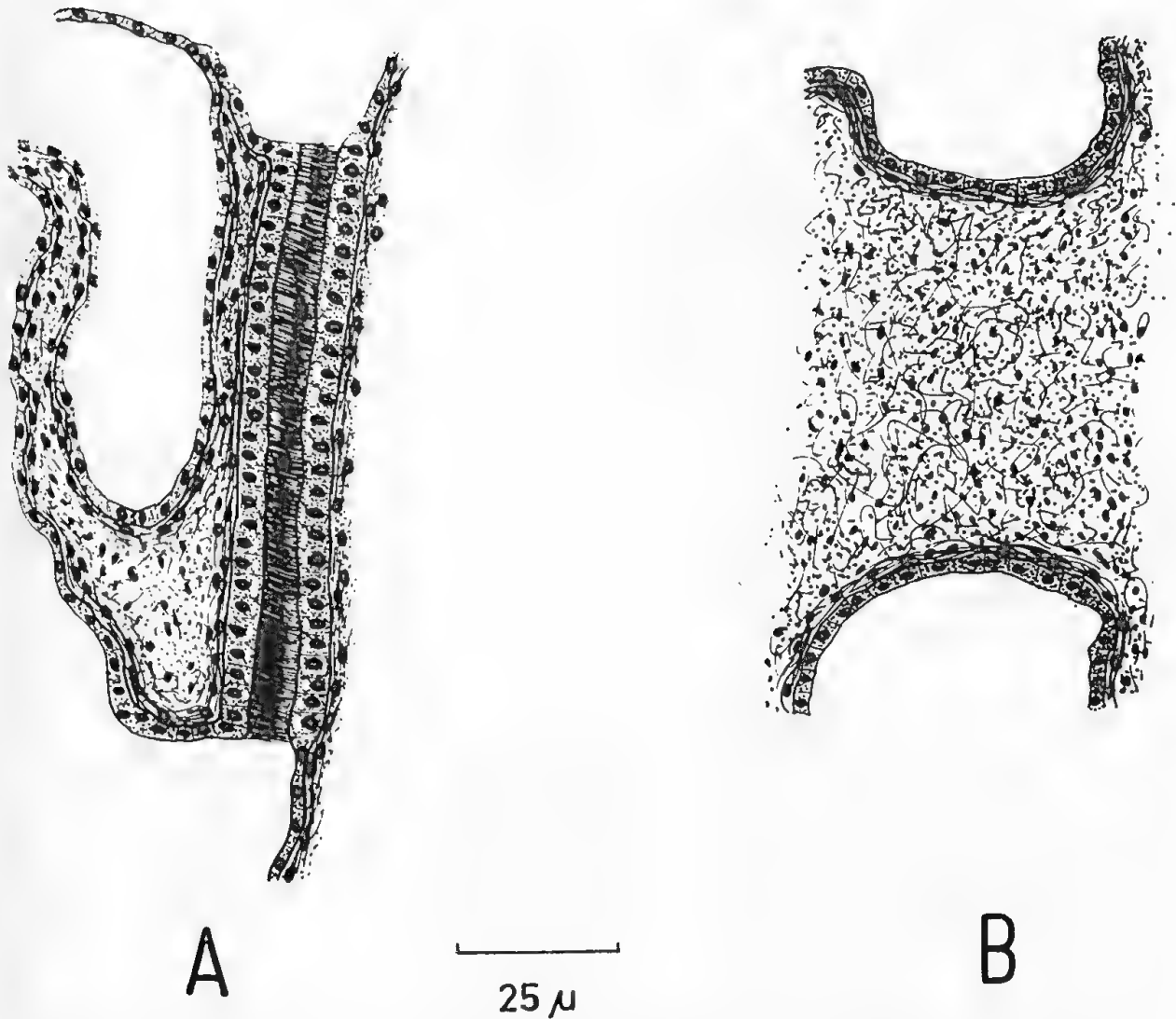


Fig. 10. *Fimbria fimbriata*. (A), the mode of attachment of the ascending lamella of the inner demibranch to the visceral mass. (B), the ctenidial axis. (For abbreviations see page 419.)

fleshy inner and outer lips (LP) of the mouth (MO). The lips possess rejectory currents which pass material laterally to the palps. The ctenidia pass between the palps, this being junction category 3 (Stasek, 1963) and typical of a condition seen in many bivalves including all the Lucinacea.

The "mantle palps"

The "mantle palps" (Fig. 14; IMP; OMP) are flaps of the inner surface of the mantle hanging in the anterior mantle cavity close to the mouth and anterior adductor muscle (AA). Allen and Turner (1970) and Boss (1970) following Pelseneer (1911) named them "mantle gills" ascribing a respiratory function to them since they are endowed with a good, secondary blood supply directly from the heart. Allen and Turner (1970), however, acknowledged that these structures might have a sensory and directional function. In section (Fig. 12A) the mantle palps are triangular in shape with an outer lateral surface (OMP), an inner surface (IMP) and an inner lateral surface. They are well ciliated and the

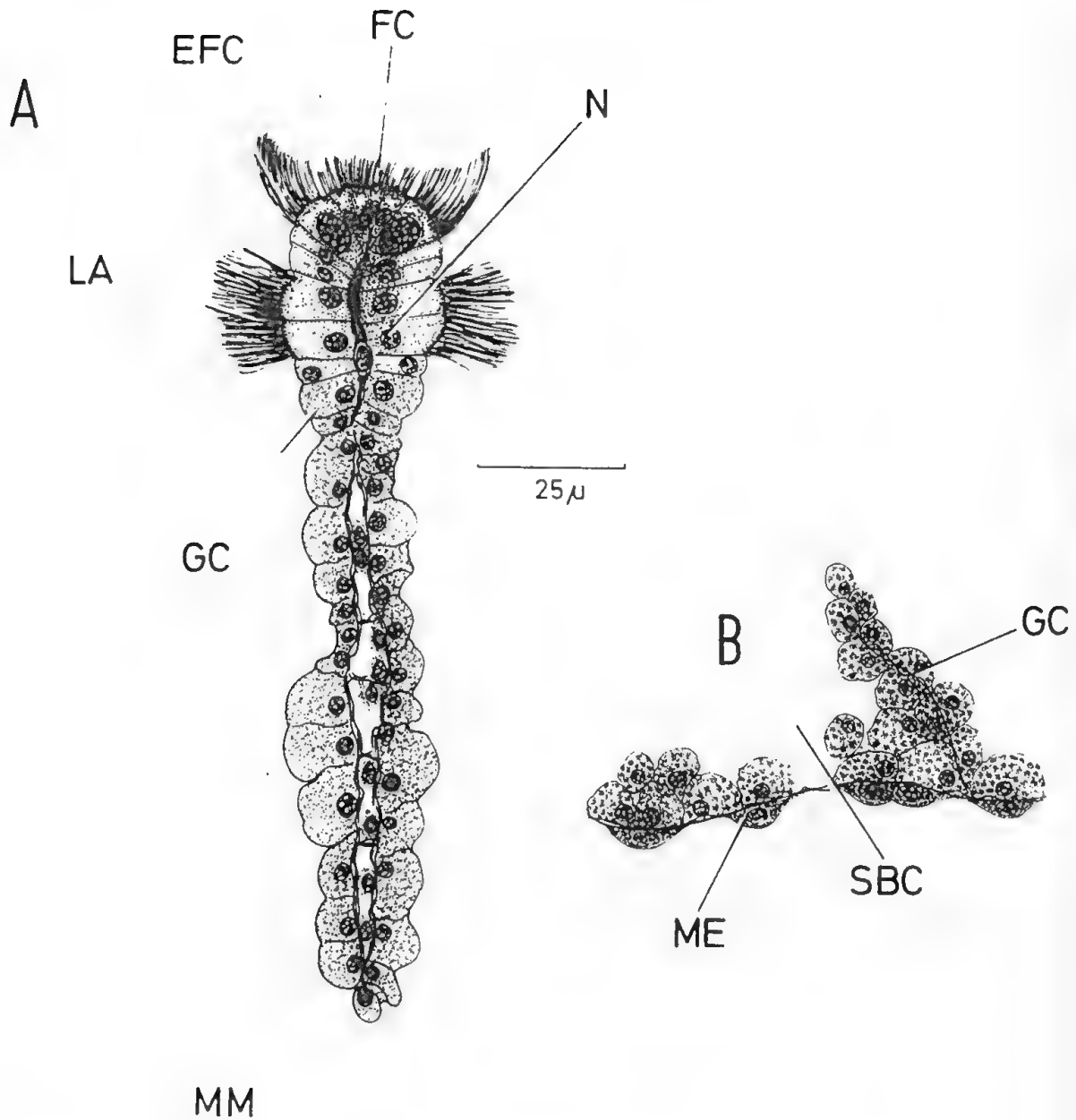


Fig. 11. *Fimbria fimbriata*. (A), The structure of a single ctenidial filament as seen in transverse section. (B), The granular cells which line the supra-branchial chamber. (For abbreviations see page 419.)

ciliary currents on their lateral outer surface (Fig. 14; OMP) are directed inwards. The inner margins of the mantle palps are fringed and on their inner surface (IMP) the ciliary currents are directed outwards and upwards from a dorsally directed central tract which takes material close to the mouth. The ciliary tracts on the inner lateral surface (Fig. 12A) pass material inwards and upwards towards the mouth. The inner and outer lateral surfaces of the mantle palps possibly trap or collect material arriving in the mantle cavity with the anterior inhalant stream (Fig. 16). The inner surface of the mantle palps, it is here suggested, serve to remove material from the foot which can, as will be discussed later, be considered the major food collecting organell. The inner surface of the mantle palps possibly wrap

around the foot as it is withdrawn into the mantle cavity removing particulate material from it by entrapping such material in the copious amounts of mucus produced by the epithelium of the inner surface of the mantle palp. Sections of the mantle palp show that the outer and inner lateral palp surfaces (Fig. 15B) comprise a squamous, non-secretory epithelium. The inner surface, however, comprises a mucous producing columnar epithelium (MC), 22 tall, that is also ciliated. Interspersed between these cells are other large globular secretory cells (SC).

The mantle palp arises as a fold (Fig. 12A and B; Fig. 14) from the junction of the ctenidial axis and mantle in the anterior half of the mantle cavity. The ciliary currents on the flap, prior to its enlargement to form the triangular-shaped mantle palp, pass material from the outer surface to the inner. The ciliary currents on the inner surface beat dorsally and contribute to an orally directed tract in the axis of the mantle palp and ctenidium (Fig. 12B).

The ciliary currents of the visceral mass

The ciliary currents of the visceral mass (Fig. 17) complement those of the mantle and the ctenidia. Postero-dorsally a weak anteriorly directed current gives way, where the fold of the mantle palp begins, to a strong anterior oralward current or acceptance tract located in the junction of mantle palp and visceral mass. In the dorsal half of the visceral mass the

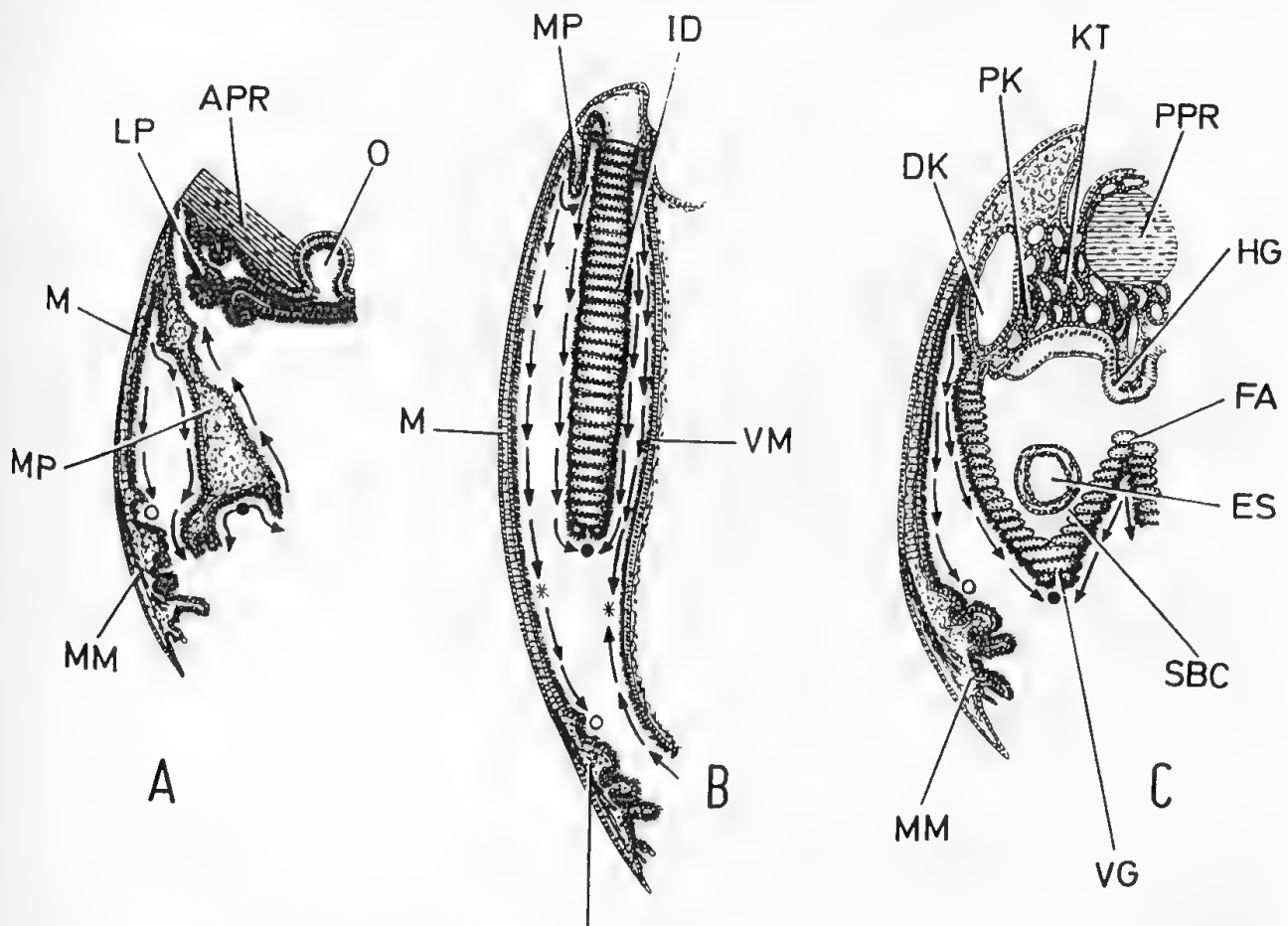


Fig. 12. *Fimbria fimbriata*. Semi-diagrammatic representations of transverse sections through the left side of the body. (A), anterior; (B), mid line; (C), posteriorly. (Closed circles = acceptance tracts; open circles = rejection tracts; * = areas of ciliary confluence). (For abbreviations see page 419.)

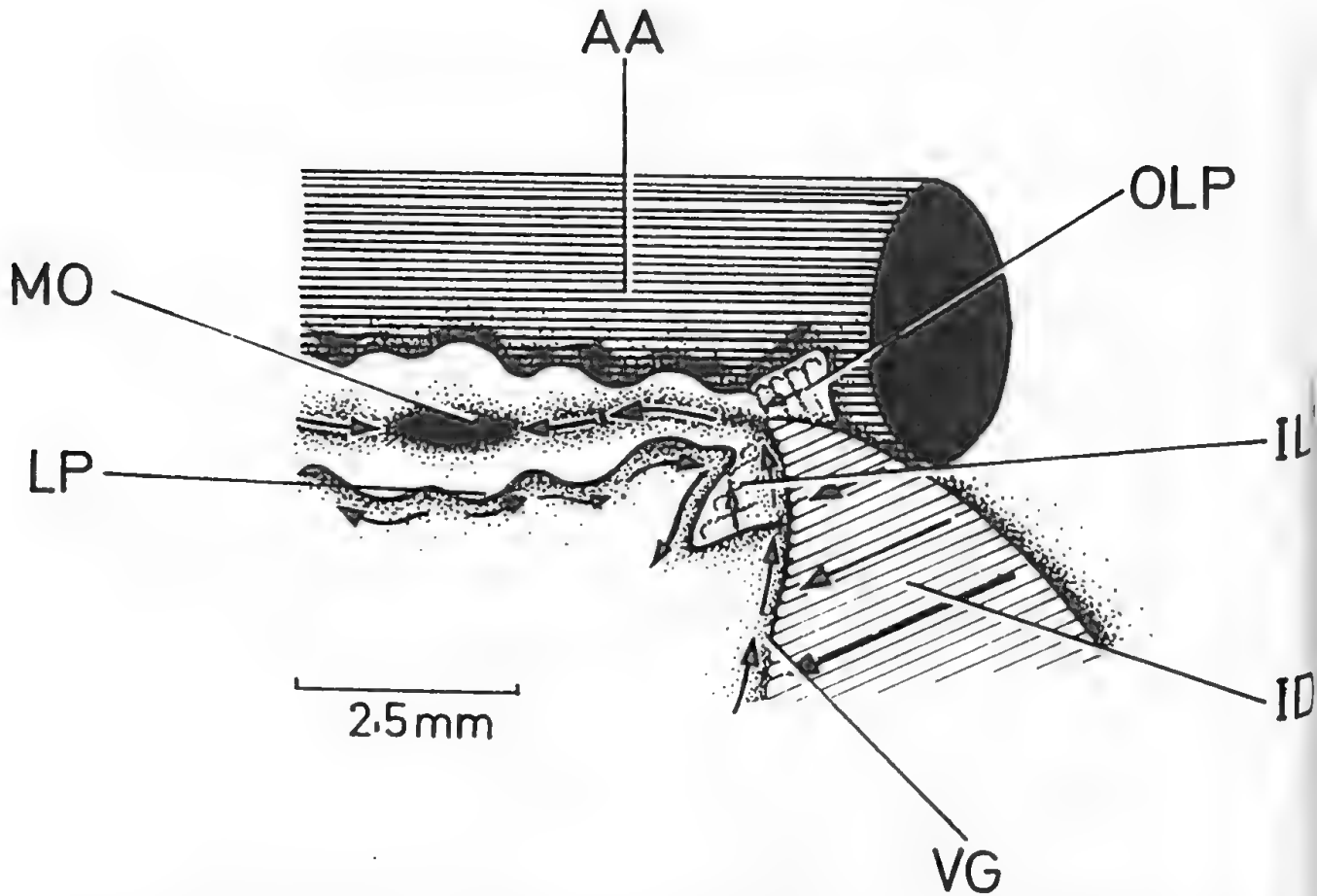


Fig. 13. *Fimbria fimbriata*. The mouth, lips and labial palps of the left side. (For abbreviations see page 419.)

currents are directed ventrally and contribute to longitudinal rejectory tracts that pass particles posteriorly from the anterior half and anteriorly from the posterior half of the visceral mass. These longitudinal tracts are also contributed to by the dorsally directed ciliary currents of the foot (F(T)). The confluence of these currents in the centre of the visceral mass results in material being circulated in a clockwise direction on the right side and in an anti-clockwise direction on the left side. The position of this area of confluence on the visceral mass approximates the position of the similar, but opposing directional ciliary confluence on the mantle. Thus, particles arriving in this region are wound into two mucous-bound streams that are removed by the major ventral rejectory tracts of the mantle to be expelled as pseudofaeces from the inhalant siphon (IS).

The foot

In the Lucinacea the tip of the foot is modified to form a long narrow tubular structure that is used to create and maintain the anterior inhalant tube. The posterior heel of the foot is locomotory. Allen and Tuner (1970) envisaged that the foot of *Fimbria fimbriata* similarly built the inhalant tube, but this is not so and the copious amounts of mucus produced by the foot are not used to bind together the sand grains of the tube, but are for the collection of sediment for food. The anterior tip of the foot (Fig. 17, F(T)) possesses strong ciliary currents that carry particles upwards towards the currents of the ctenidia and visceral

mass. The secretory areas of the foot are more dense towards the tip and comprise two types of subepithelial secretory cells. More granular eosinophilic secretory cells (Fig. 18 SC(E)) lie just under the foot epithelium, which, as noted by Allen and Turner (1970), is internally ringed by a thin layer of circular muscle. Internal to and overlapping with the eosinophilic cells are large numbers of basiphilic cells. Internal to these can be found bundles of longitudinal muscle fibres (LM) and radiating out from the centre of the foot, which possesses a central blood space, are numerous radial muscle bands (RM). The epithelium of the foot, comprising columnar cells 14 tall, is densely covered by cilia 5 long. Further evidence that the tip of the foot serves as a food collecting organelle and not a tube building structure, comes from a single specimen of *F. fimbriata* 76 mm long which had no

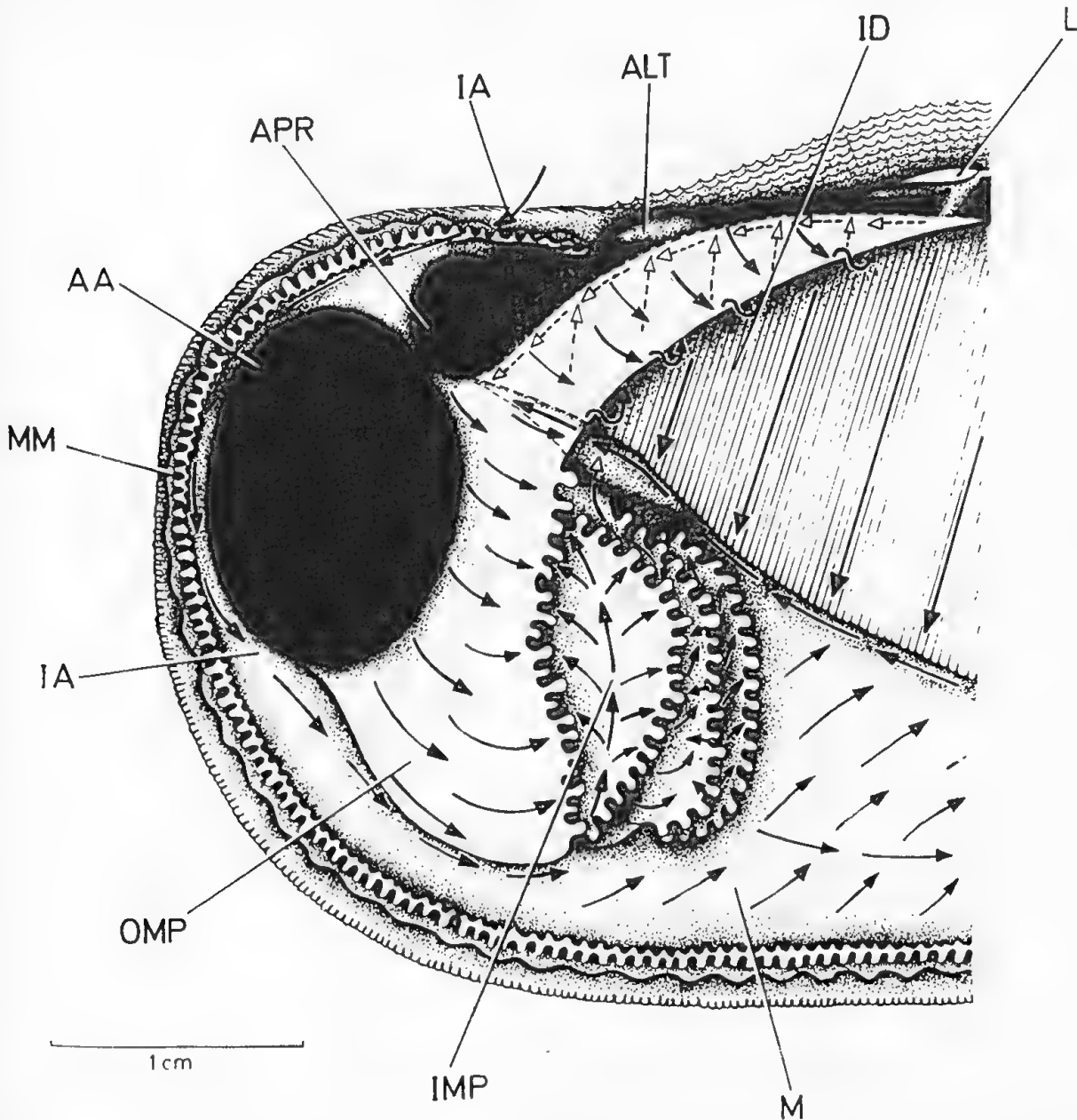


Fig. 14. *Fimbria fimbriata*. The ciliary currents of the anterior region of the mantle cavity, viewed from the left side after removal of the left shell valve and mantle lobe. (Closed arrows = ciliary tracts; open arrows = ciliary currents on the inner surface of the posterior region of the mantle palp). (For abbreviations see page 419.)

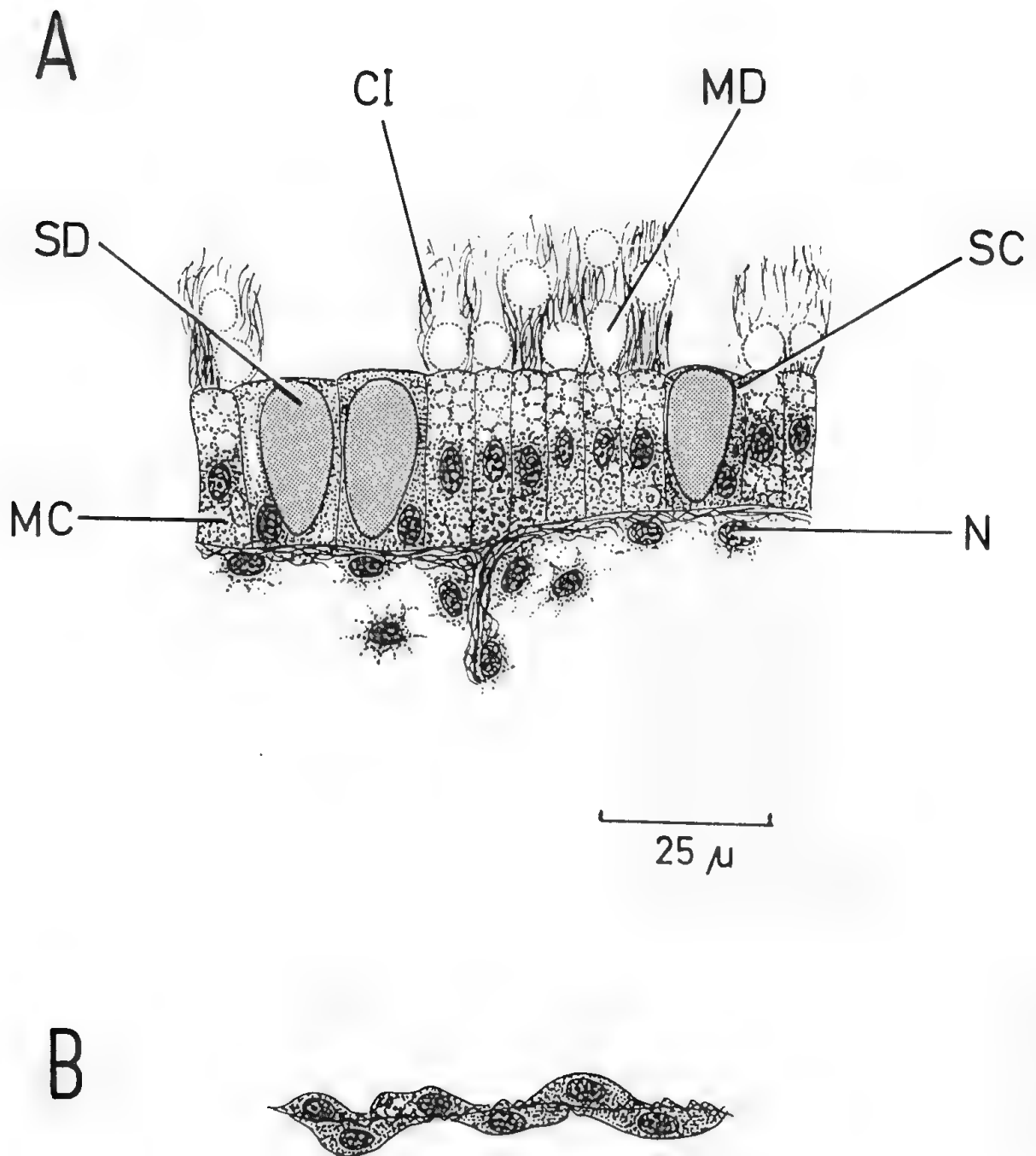


Fig. 15. *Fimbria fimbriata*. The structure of (A) the secretory epithelium of the inner surface of the mantle palp and (B), the outer surface. (For abbreviations see page 419.)

tip to the foot but which could still create the typical anterior inhalant depression in the sand. The small size of the heel (F(H)) of the foot indicates, as suggested by Allen and Turner (1970), that *F. fimbriata* is not a fast burrower. This is true.

The hypobranchial gland

The posterior surface of the visceral mass and the surface of the supra-branchial chamber is covered by an epithelium that has virtually all the characteristics of a hypobranchial gland (Fig. 19, HG) hitherto reported only from the Protobranchia e.g. *Nucula delphinodonta* (Drew, 1901) and prosobranch gastropods (Fretter and Graham, 1962).

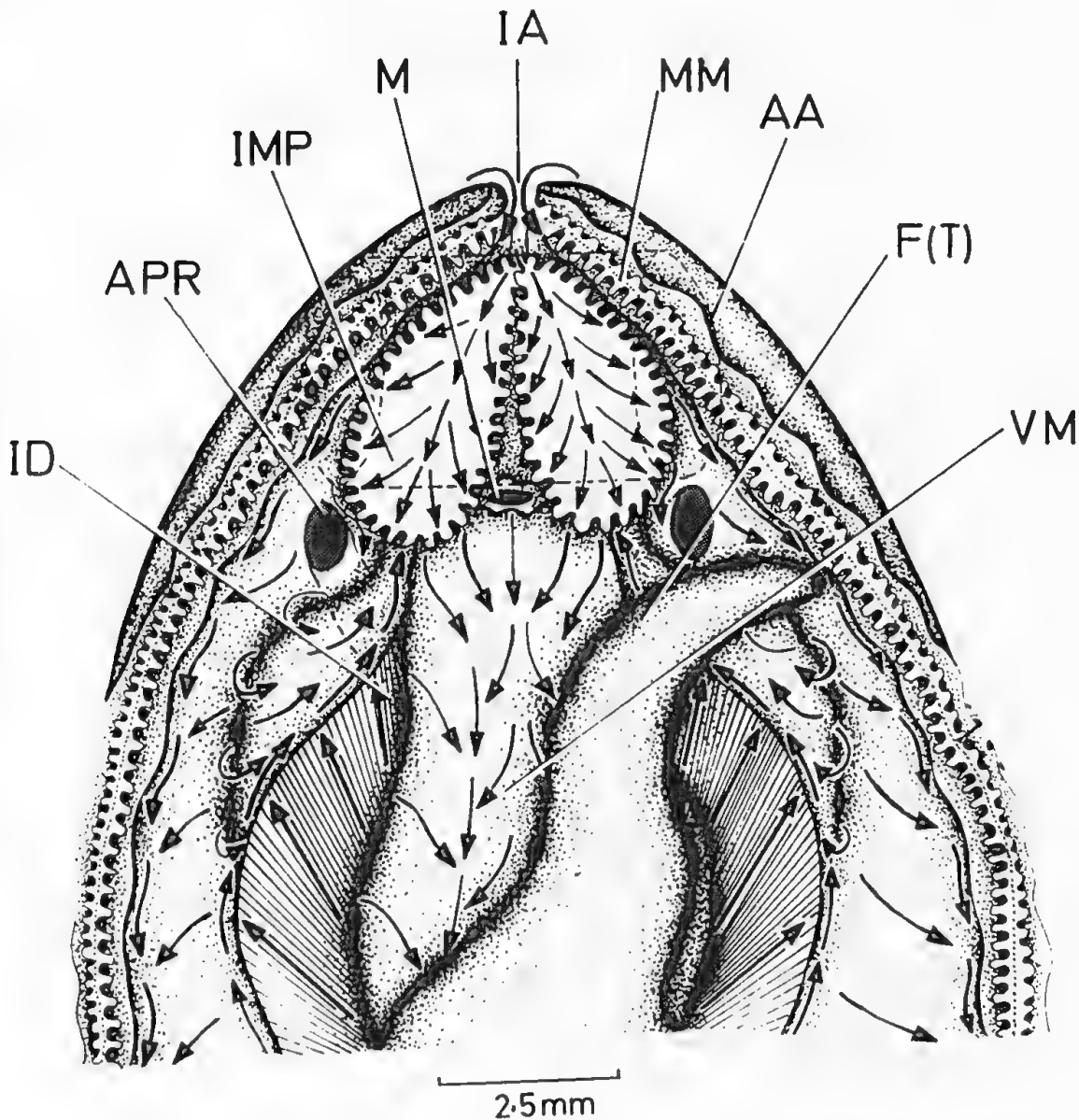


Fig. 16. *Fimbria fimbriata*. A ventral view of the organs of the mantle cavity, showing their ciliary currents. The animal has been removed from the shell. (For abbreviations see page 419.)

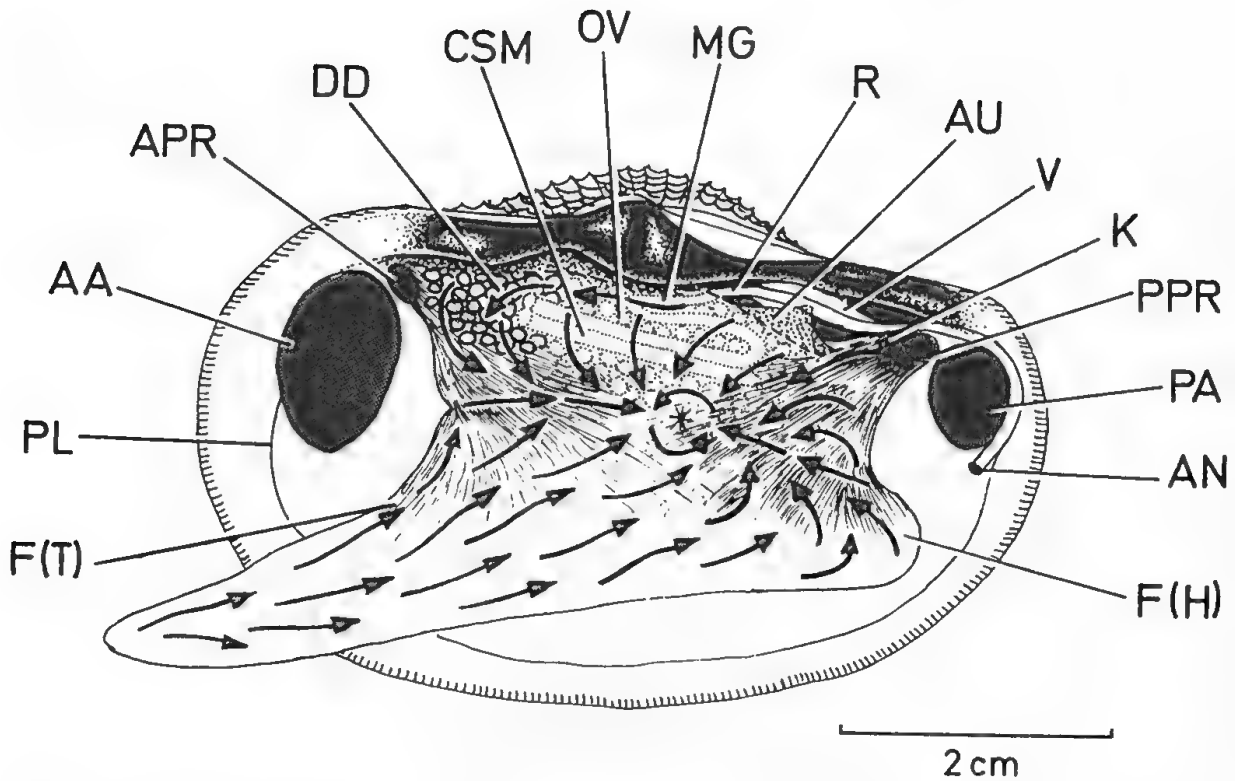


Fig. 17. *Fimbria fimbriata*. The ciliary currents and structure of the foot and visceral mass viewed from the side after removal of the left shell valve, mantle lobe and ctenidium. (* = area of ciliary confluence). (For abbreviations see page 419.)

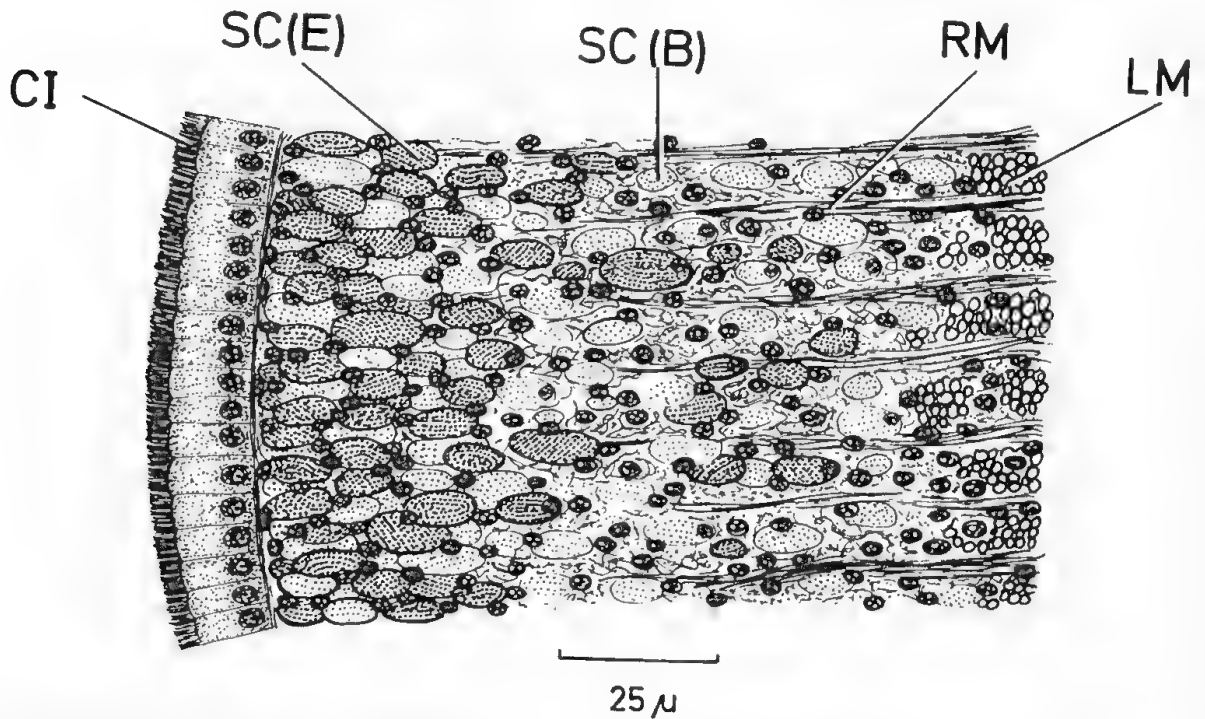


Fig. 18. *Fimbria fimbriata*. A semi-diagrammatic representation of a transverse section through a portion of the tip of the foot. (For abbreviations see page 419.)

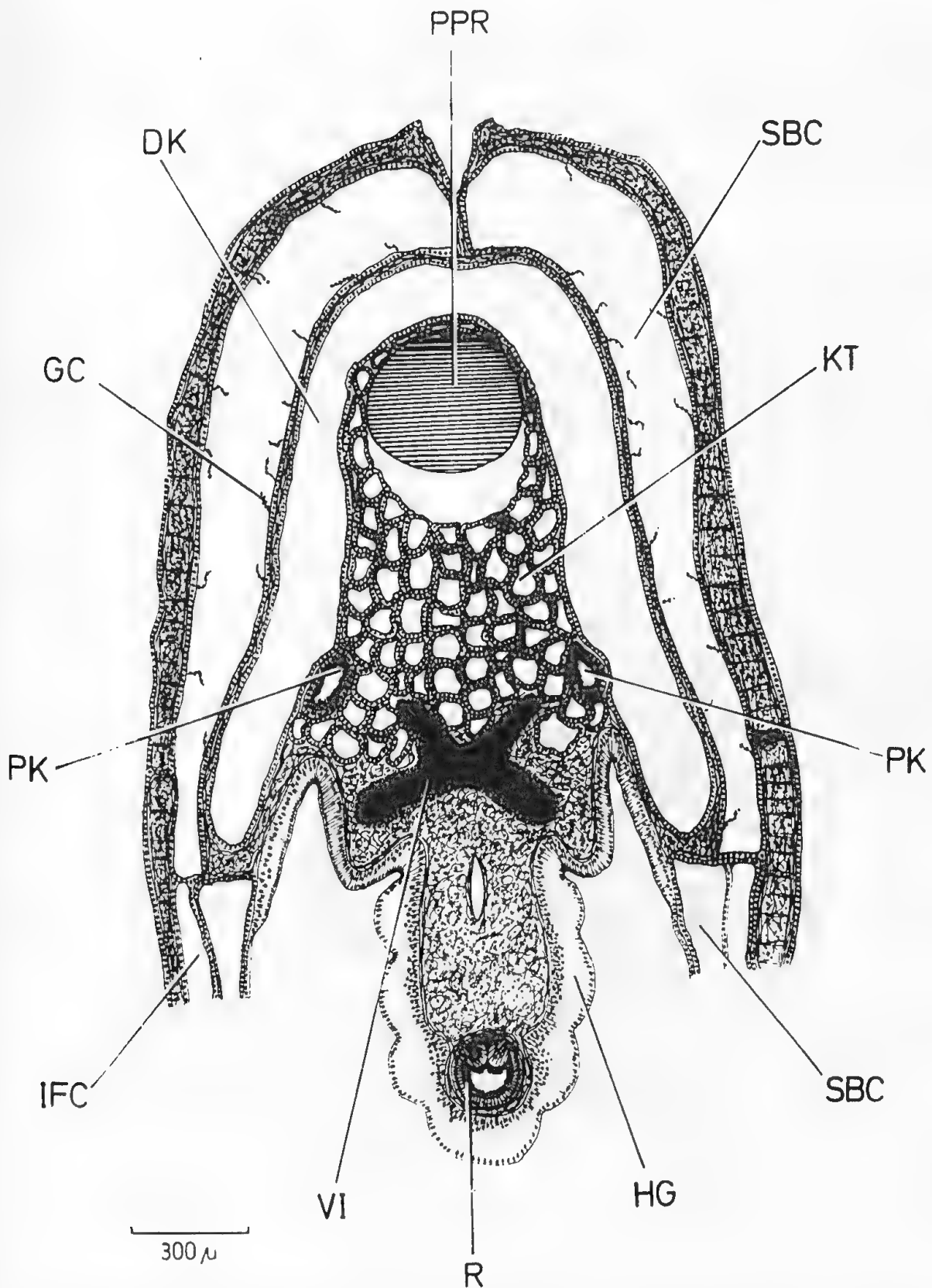


Fig 19. *Fimbria fimbriata*. A semi-diagrammatic representation of a transverse section through the posterodorsal region of the body. (For abbreviations see page 419.)

The detailed structure of the hypobranchial gland of *Nucula*, *Solemya*, *Fimbria* and *Corbicula* has recently been described by Morton (1977) but it is pertinent to briefly describe it here. The gland comprises two cell types, a tall columnar epithelium of mucous secreting cells 100-120 μ tall interspersed at the apices by small inversely flask-shaped cells of unknown but possibly regenerative function. These cells are not ciliated as they are in *Solemya* and *Nucula*. The possible function of such an extensive gland in *F. fimbriata* will be discussed later.

THE DIGESTIVE SYSTEM

The oesophagus

The oesophagus is very long (not short as suggested by Boss (1970)) and (Fig. 21A) passes upwards from the mouth which in turn lies under the anterior pedal retractor muscle. In transverse section the oesophagus which is some 160 μ in diameter, comprises a ciliated epithelium that is thrown into 11 pleats; four dorsally, seven ventrally. The cells range in height from 25-60 μ and the cilia are 10 μ long. The oesophagus enters the stomach anteriorly (Fig. 20, O).

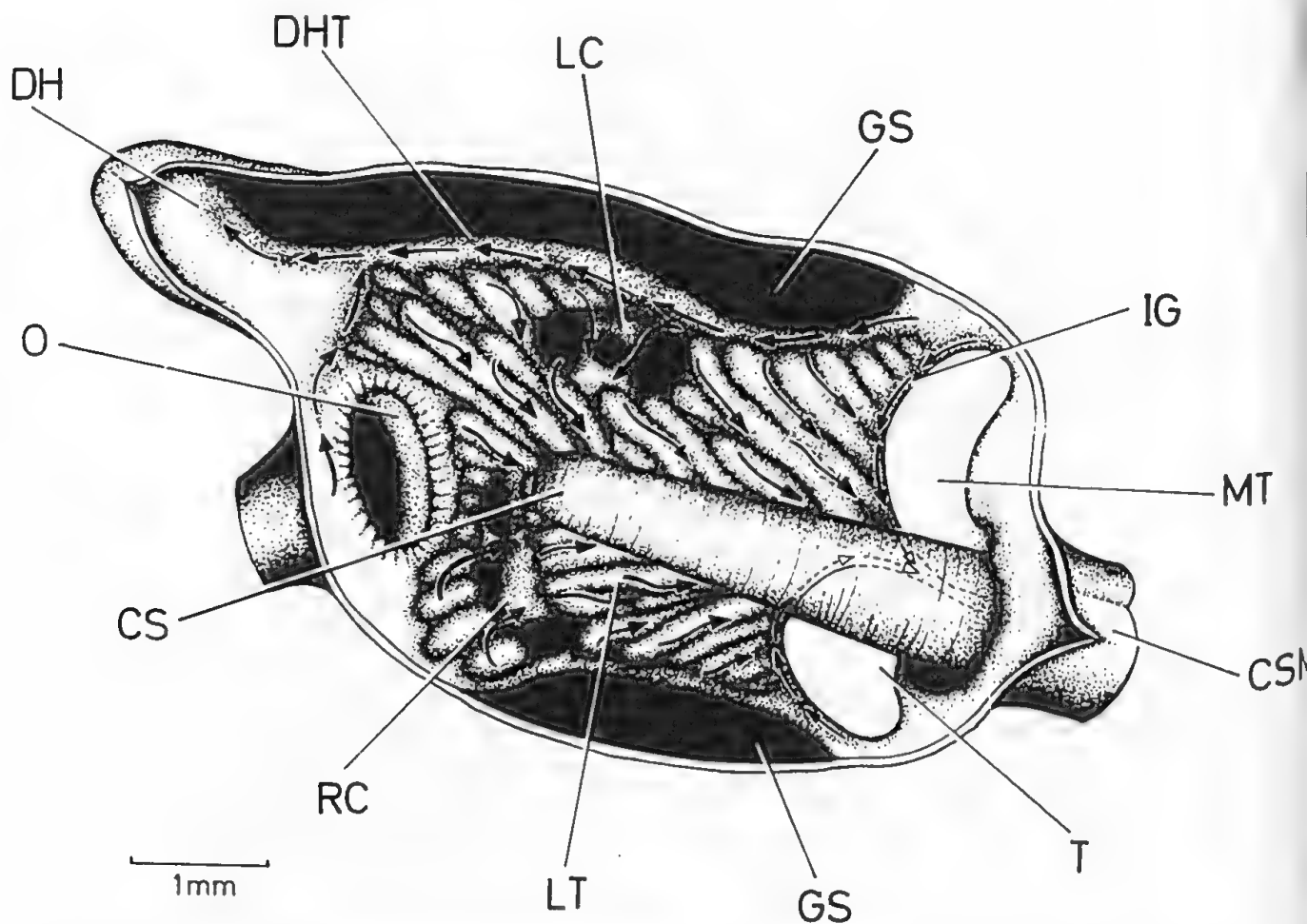


Fig. 20. *Fimbria fimbriata*. The structure and ciliary currents of the internal surface of the stomach after being opened via a dorsolateral incision in the left wall. (For abbreviations see page 419.)

The stomach

The structure of the stomach of *Fimbria fimbriata* has been reconstructed from sections by Allen and Turner (1970) but this study is of the living animal. The elongate, thin walled stomach (Fig. 20) is of type IV (Purchon, 1958) and is very simple. There are two typhlosoles, the minor (MT) and the major (T). Both arise from the conjoined style sac and mid gut (CSM) and flare out onto the floor of the stomach, where they terminate. The crystalline style (CS) is small and rotates against an extensive gastric shield (GS) that lines the left side of the roof of the stomach and the dorsal hood (DH). No spur of the gastric shield is sent into the apertures leading to the digestive diverticula though there is, as noted by Allen and Turner (1970), a tooth anterior to the lower side. There is a ciliated tract — the dorsal hood tract (DHT) — recirculating material to the dorsal hood and gastric shield and is located just below the gastric shield on the left side of the stomach.

The floor of the stomach comprises a series of longitudinal folds or pleats (LT) that extend towards the intestinal grooves (IG) of both minor and major typhlosoles. Down longitudinal furrows that are located between the pleats is carried particulate material that is, presumably, too large to be taken into the openings to the ducts of the digestive diverticula. The openings to the digestive diverticula are, however, large.

According to Allen and Turner (1970) the digestive diverticula open into the stomach via "three ducts close together on the right hand side, one large duct on the left and a second large duct ventral and posterior to the latter on the floor of the stomach." Certainly three ducts open into the stomach on the right side close together and constitute the right caecum (RC). On the left side, the two separate ducts referred to by Allen and Turner (1970) are no more than the two components of the left caecum (LC). Thus the structure of the stomach is very simple, though not as simple as those lucinids e.g. *Thyasira flexuosa* and *Lucinoma borealis* described by Purchon (1958). Significantly the stomach of *F. fimbriata* is more similar to that of the lucinids *Lucinoma* (Purchon, 1958), *Lucina* and *Loripes* (Allen, 1958) than it is to other members of the Lucinacea.

The style sac

The style sac and mid gut are conjoined and pass from the posterior edge of the stomach into the visceral mass posteriorly (Fig. 17, CSM). They do not penetrate the foot deeply as in many other bivalves e.g. *Geloina erosa* (Morton, 1976b). The structure of the separated mid gut will be described later.

In transverse section (Fig. 21D) the style sac, which is some 280 μ in diameter, is seen to comprise a number of epithelial zones earlier recognised for a number of other bivalves by Kato and Kubomura (1954) and by Morton (1969, 1973b,c, 1976a,b). The A cell layer comprises a columnar epithelium of cells 25 μ tall and possessing cilia (CI) 10 μ long. The nucleus of these cells is located basally. The A cell layer constitutes some 50% of the epithelium of the style sac and is thought to facilitate the rotation of the style (CS). The A cell layer is separated from the mid gut, which is lined by a short (10 μ) sparsely ciliated cell layer, by the two typhlosoles — major (T) and minor (MT(B₁)). In *F. fimbriata* the cells of the minor typhlosole (MT(B₁)) are modified and possess a granular cytoplasm. They are some 100-120 μ long and possess an elongate nucleus 10 μ long located in the centre of the cell. They are sparsely ciliated by cilia 10 μ long and from the distal surfaces of these cells could be seen secretory droplets in the process of being budded off and which had formed a layer of unsolidified style material (US) around the solid crystalline style. Similarly Goreau, Goreau and Yonge (1966) and Bernard (1973) have shown that the typhlosoles of

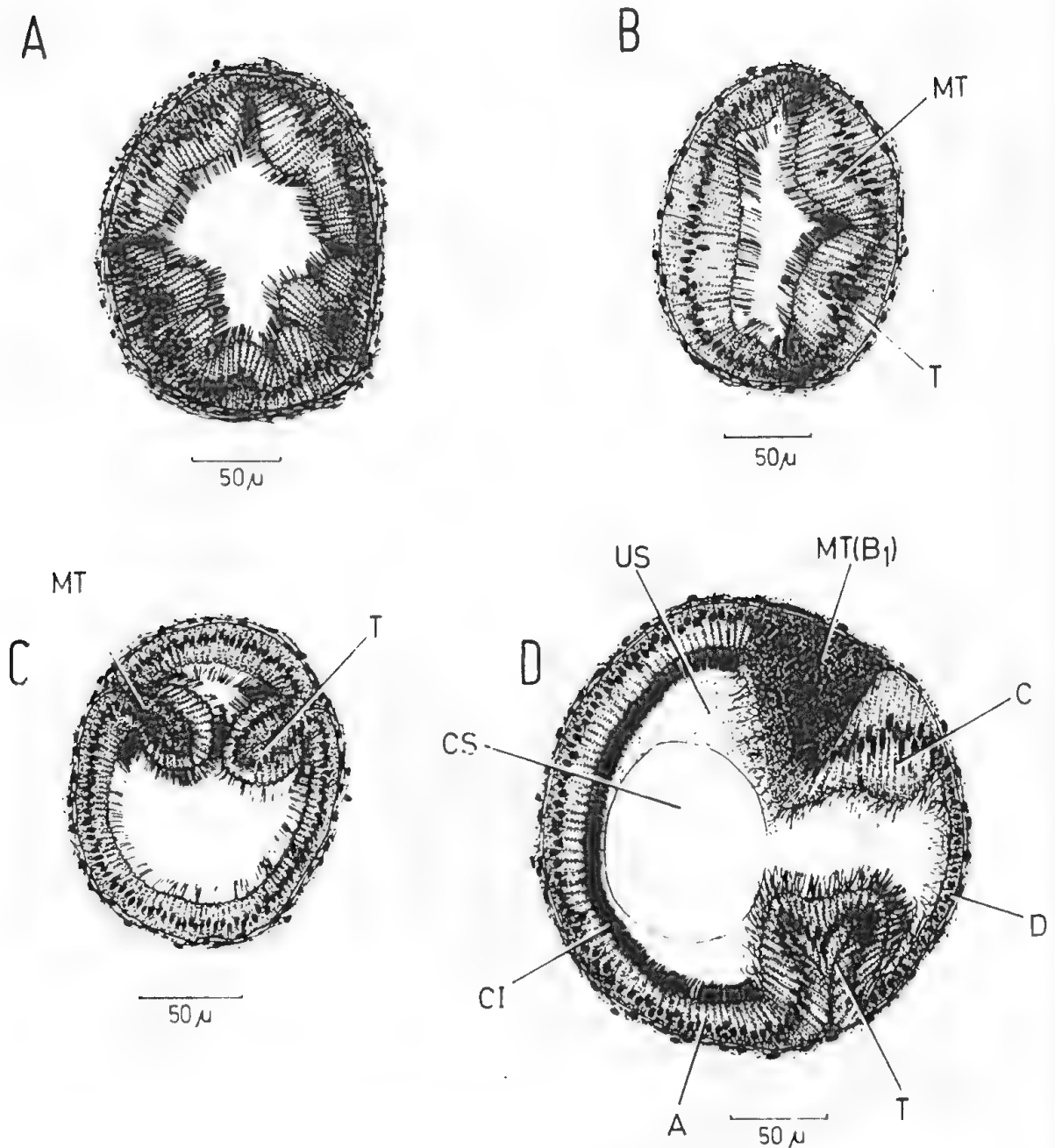


Fig. 21. *Fimbria fimbriata*. Transverse sections through (A), the oesophagus; (B), the mid gut; (C), the rectum and (D), the conjoined style sac and mid gut. (For abbreviations see page 419.)

Tridacna and *Crassostrea* are secretory. Opposite the minor typhlosole is the major typhlosole (termed the B cell layer in other bivalves) which in the case of *F. fimbriata* appears little modified and comprises cells approximately 80 μ tall with a central nucleus and long cilia distally. Abutting the B₁ cell layer (the minor typhlosole) can be seen a group of cells which appear to be a modified region of the minor typhlosole. They too are tall (100 μ) and possess an elongate nucleus. The cilia they possess are long and sparse, though the ciliary rootlets are easily discernible within the cells. These cells are reminiscent of the C cell layer of other bivalves e.g. *Dreissena polymorpha* (Morton, 1969) though they do not

possess the short stiff cilia of these bivalves. The D cell layer (the mid gut) unites the two typhlosoles. In other bivalves this region of the style sac and mid gut secretes the matrix of the style, e.g. *D. polymorpha* and *Galeomma takii* (Morton, 1969, 1973b).

The mid gut and rectum

After separating from the style sac posteriorly, the mid gut (Fig. 17, MG) then loops back above itself to pass anteriorly. It undertakes another turn to penetrate the ventricle (V) of the heart as the rectum (R). The rectum passes over the posterior adductor muscle (PA) and terminates on the posteroventral face of this muscle as the anus (AN).

In transverse section (Fig. 21B) the mid gut is some 130 μ in diameter and possesses both minor (MT) and major typhlosoles (T), the cells being some 40-45 μ tall and possessing cilia 12 μ long. The opposite side of the mid gut comprises an epithelium 50 μ tall which also possesses long cilia.

The rectum, some 125 μ in diameter, (Fig. 17C) also possesses the two typhlosoles which are reduced to small prominent flaps composed of cells 18-20 μ tall possessing long cilia. The remainder of the rectum comprises an epithelium of approximately similar height, similarly ciliated.

THE PERICARDIUM AND THE KIDNEY

The pericardium lies under the ligament. The heart (Fig. 17) comprises a single ventricle (V) and two auricles (A) — the latter being somewhat pigmented. The ventricle is penetrated by the rectum (R).

The black kidney (K) lies behind the pericardium and lines the anterior faces of the posterior pedal retractor muscles (PPR). From the posteroventral surfaces of the pericardium arise two renopericardial apertures which open into the small ciliated proximal ducts of the kidney (Fig. 19, PK). These ducts posteriorly communicate with the much larger and non-ciliated distal limb of the kidney (DK) which opens into the supra-branchial chamber via a slit-like renal aperture ventrally. The distal limbs of the kidney communicate one with the other above the posterior pedal retractor muscles (PPR). The walls of the distal limbs of the kidney comprise a system of meandering tubules similar in structure to those of *Laternula truncata* and *Cleidothera maorianus* (Morton, 1973c, 1974). The cells of the kidney are some 12-15 μ tall and contain few yellowish concretions.

DISCUSSION

Scientific interest in *Fimbria fimbriata* centres around its systematic status; Nicol (1950) creating a new family for it — the Fimbriidae. Allen and Turner (1970) argued, however, that the species is a member of the Lucinidae and this latter assertion gains considerable support from the results of this study. Boss (1969, 1970), however, did not question the creation of a new family by Nicol (1950), but acknowledged that the Fimbriidae and Lucinidae were very close phylogenetically.

The general similarity of the shell of *Fimbria* to that of the Lucinacea, is enhanced by the researches of Taylor, Kennedy and Hall (1973) who have shown, on the basis of shell structure and mineralogy, that the shell of *Fimbria* is essentially similar to the shell of members of the Lucinidae. *Fimbria*, as in other lucinids (Allen, 1958) possesses but one demibranch that Purchon (1939) considered to be the outer but which Allen (1958) showed

to be the inner. The ciliary currents of the single demibranch are of type G (Atkins, 1937b). In the Ungulinidae and Thyasiridae both demibranchs are present — Boss (1969) unwisely suggesting that "the Diplodontidae and Thyasiridae have secondarily evolved an external demibranch." The detailed structure of the ctenidial filament of *Fimbria* is also similar to that of the lucinid *Divaricella quadrisulcata* whereas the filaments of *Thyasira flexuosa* possess prolatro frontal cilia (Allen, 1958).

The labial palps of *Fimbria* are reduced to mere enlargements of the lips of the oral groove as in various lucinids whereas the palps of members of the Ungulinidae and Thyasiridae are larger and possess typical ciliated folds (Allen, 1958). Most significantly *Fimbria* like *Codakia orbicularis* and *Lucina pennsylvanica* (Lucinidae) (Allen, 1958; Allen and Turner, 1970), possesses what Allen (1958) and Boss (1970) termed (following the term "pallial gills" erected for three species of *Lucina* by Pelseneer (1911)) "mantle gills"; ascribing to them a respiratory function, because they are well supplied with blood. In *Fimbria*, however, they possess a different function. They wipe (by the production of a, presumably sticky, secretion from the epithelium of their inner surface) sand grains and detritus particles from the foot. The foot, which also possesses abundant secretory cells is the major food collecting organelle of the mantle cavity; the water above the sand being typically nutrient deficient. The mantle palps by means of the complex currents on their inner surface pass the collected material dorsally towards the mouth. In the clean, well aerated coral sands it is difficult to see why *Fimbria* should need extra respiratory surfaces. Similarly both *C. orbicularis* and *L. pennsylvanica* (Allen, 1958) live in clean coral sands and it is here suggested that in these species too the prime function of these structures is to replace the vestigial labial palps that were presumably lost early on in the adaptive radiation of the Lucinidae. A primitive trend in the Lucinacea towards reduction of the labial palps has favoured, presumably as a greater adaptive radiation in life styles subsequently ensued, the evolution of structures with an essentially similar function but different origin, i.e. the inner mantle surface. A more detailed study of the ciliary currents of the "mantle palps" (as they should possibly be more correctly termed) in the various lucinids studied by Pelseneer (1911) and Allen (1958) might more clearly reveal their true function. The stomach of *F. fimbriata* is more closely similar to that of the lucinids *Lucina pennsylvanica* and *Loripes lucinalis* (Allen, 1958) and is exceptionally simple as in those lucinids described by Purchon (1958). Extensive areas of the floor of the stomach of *F. fimbriata* remove particulate matter towards the intestinal grooves of the typhlosoles for eventual defaecation via the mid gut. This is undoubtedly a reflection of the large amounts of sediment ingested; the stomach of the anomiid *Enigmonia aenigmatica* (Morton, 1976a) is, because the animal feeds in turbid mangrove waters, convergently similar to that of *Fimbria*.

The peculiar mode of withdrawal of the exhalant siphon — so like that of the Lucinidae — is a final factor which clearly allies *Fimbria* with this family. This method of siphonal retraction appears to be unique to the Lucinidae and is a means to house and protect long siphons within the mantle cavity other than the method possessed by more conventional bivalves where the siphons are withdrawn (but not invaginated) into the infra-branchial chamber by siphonal retractor muscles. Hence the deep pallial sinus of deep burrowers e.g. the Tellinacea (Yonge, 1949).

There can be little doubt therefore that *F. fimbriata* is closely related to the Lucinidae and future research must now be directed towards deciding whether subsequently described (fossil) members of the Fimbriidae (Chavan, 1969) similarly closely recall the condition in the Lucinidae and whether there is any justification for the erection of the Fimbriidae by Nicol (1950).

McAlester (1966) has suggested that the Ordovician fossil *Babinka* is an evolutionary transition between the bivalve superfamily Lucinacea and some monoplacophoran-like ancestral bivalve. McAlester further suggests, a thesis subsequently supported by Boss (1970), that the Lucinidae are more primitive than other lucinaceans and if this is so then the primitive probing foot of *F. fimbriata* as opposed to the tube-building foot of other lucinids might indicate that *Fimbria* is one of the more primitive members of this ancient group. Moreover, the mode of life of *F. fimbriata*, lying with the antero-dorsal inhalant aperture close to the sand surface closely recalls that position postulated for *Babinka* (McAlester, 1965; Fig. 6).

Allen (1958) suggested that the Thyasiridae and Ungulinidae were more primitive because modern representatives of these families possess both ctenidial demibranchs and large labial palps. This would indicate a trend towards a reduction in the sorting of particulate material and an increase in the acceptance of large particles and thus a change from a filter feeding to a detritus feeding mode of life. The fossil record is irrefutable, however, (McAlester, 1965, 1966; Chavan, 1969; Boss, 1970), and as noted by Boss (1970) "the geological record itself provides a better clue to phylogeny than do inferences based on supposed anatomical features of fossil lineages".

It would thus seem that *Fimbria* is the sole surviving genus of an ancient lineage that is closely allied to the Lucinidae. It has retained a number of primitive features which give a greater insight into the mode of life of the early bivalve *Babinka*. The taxonomic status of the Fimbriidae must await a close examination of the fossil members of this group and their comparison with fossil lucinids.

The unique features of the Lucinacea certainly set them apart from all other bivalves and McAlester (1966) concludes that they should be treated as a separate bivalve taxon of "the highest rank" that are probably unrelated to most other "heterodont" forms with which they are commonly associated (Newell, 1965, 1969). More extensive comparative researches are therefore needed upon the functional morphology of the Heterodonta. Neumayr 1884 to determine the validity of this assertion. Boss (1970), however, disagrees with this view and summarises his arguments thus: "I have shown that the Lucinacea, old and persevering, are distinctly and obviously heterodont". There can be no doubt that the Lucinacea are phylogenetically old and though possessing unusual, possibly primitive, features, the major features of their morphology, as detailed by Boss (1970) and further in this study, do ally them with the Heterodonta and with the mainstream of eulamellibranch evolution.

The Lucinacea are, however, closely allied to the Leptonacea Gray 1847 which comprise a large group of typically small, often symbiotic (a term used here in the widest possible sense) bivalves which have simple mantle fusions, an anterior inhalant aperture, a posterior exhalant siphon, a wide pedal gape and a foot similar to that of *Fimbria*, and used only in locomotion and attachment but not in feeding. Many leptonaceans similarly also only possess a single, inner demibranch.

There can be little doubt that *Fimbria* possesses many primitive features. Not the least of these is the presence of a hypobranchial gland with a structure similar to that of the hypobranchial gland of *Nucula* and *Solemya* (Morton, 1977). In *Fimbria* the hypobranchial gland lines the roof of the suprabranchial chamber, behind the visceral mass and under the rectum — a position similar to that seen in the primitive protobranchs. The structure of the hypobranchial gland of *Fimbria* strongly suggests a secretory function which in the primitive "protobranch" bivalves was thought to coalesce particles leaving via the exhalant stream. Since in this "lamellibranch" particles are filtered out on the ctenidia, few reach the suprabranchial chamber. The gland possibly possesses a function similar to that seen in

the prosobranch *Gibbula* (Gersch, 1936) and the protobranch *Nucula delphinodonta* (Drew, 1901) where a secretion is produced to nourish externally protected eggs. In the lamellibranch *Corbicula fluminea* (Morton, 1977) the gland nourishes larvae developing within the inner demibranch. Given the close relationship existing between the Lucinidae (and *Fimbria*) and the Leptonacea — a superfamily which characteristically incubate eggs within a ctenidial marsupium — is it possible that *F. fimbriata* also incubates its eggs within the supra-branchial chamber and nourishes them with a secretion from the hypobranchial gland? Possibly the hypobranchial gland in the Bivalvia is a structure producing a secretion that was primitively concerned with the cleansing of the mantle cavity but which has, with the evolution of the lamellibranch ctenidium, come to be used to nourish incubated young. Significantly the supra-branchial chamber of *Fimbria* is capacious and lined by peculiar granular cells that possibly possess an excretory function in the Thyasiridae (Allen, 1958).

Despite primitive features *Fimbria* must also be examined with regard to the specialisations that adapt it for life in nutrient deficient tropical coral sands. *F. fimbriata* is infaunal utilising an anterior inhalant stream to maintain a supply of oxygen-rich water for respiration. In the same water stream may be carried food particles that are filtered on the ctenidia and carried orally. The major food source is, however, the sand grains and detritus collected by the sticky probing tip of the foot. Such material is transported to the mantle cavity by cilia and removed from the foot by special "mantle palps" that transport it towards the mouth. Complex and highly efficient rejectory tracts on the mantle and visceral mass remove sediment towards the posterior inhalant siphon where it is expelled, mucus bound, into the sand as pseudofaeces. *Fimbria* probably progresses forwards as it feeds and the posterior exhalant siphon is possibly periodically retracted and re-extended as it moves, albeit slowly. The alimentary canal, particularly the stomach, is similarly modified to receive large amounts of ingested food material; there being few sorting areas and extensive rejection tracts. In addition there are few apertures (but with large openings) leading to the digestive diverticula. Finally the stomach does not possess an appendix for the temporary storage of unwanted particulate material (Reid, 1965) as in the other major phylogenetic group — the Tellinacea — that has colonised coarse sands and are detritus feeders (Yonge, 1949).

The function morphology of *F. fimbriata* must thus be viewed from a number of perspectives. It has many specialised features adapting it to a life in clean coral sands, but the major interest lies in the primitive features that tell us more of the life style of an old bivalve lineage.

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ABBREVIATIONS USED IN THE FIGURES

A	A cell layer of the style sac
AA	Anterior adductor muscle or scar
ALT	Anterior lateral hinge tooth
AN	Anus
APR	Anterior pedal retractor muscle or scar
AU	Auricle
C	C cell layer of the style sac
CS	Crystalline style
CSM	Conjoined style sac and mid gut
CT	Cardinal tooth
D	D cell layer of the style sac
DD	Digestive diverticula
DH	Dorsal hood
DHT	Dorsal hood tract
DK	Distal limb of the kidney
EFC	Eulaterofrontal cilia
ES	Exhalant siphon
F(H)	Foot (heel)
F(T)	Foot (tip)
FA	Point of fusion of ascending lamellae of inner demibranchs
FC	Frontal cilia
FIF	Fused inner mantle folds
FO	Ctenidial axis
GC	Granular cell
GS	Gastric shield
HG	Hypobranchial gland
IA	Inhalant aperture
ID	Inner demibranch
IF	Inner mantle fold
IFC	Infrabranchial chamber
IG	Intestinal groove
IL	Inner ligament layer
ILP	Inner labial palp
IMP	Inner surface of "mantle palp"
IS	Inhalant siphon
K	Kidney
KT	Kidney tubules
L	Lunule
LA	Lateral cilia
LC	Left caecum
LI	Ligament
LM	Longitudinal muscles
LP	Lips of the mouth
LT	Longitudinal tracts
M	Mantle
MA	Mantle papilla
MC	Mucous cell
MD	Mucous droplet
ME	Mantle epithelium
MF	Middle mantle fold

MG	Mid gut
MM	Mantle margin
MO	Mouth
MP	"Mantle palp"
MT;MT(B1)	Minor typhlosole
N	Nucleus
O	Oesophagus
OF	Outer mantle fold
OLP	Outer labial palp
OMP	Outer surface of "mantle palp"
OV	Ovary
P	Periostracum
PA	Posterior adductor muscle or scar
PG	Periostracal groove
PK	Proximal limb of the kidney
PL	Pallial line
PLT	Posterior lateral hinge tooth
PM	Pallial musculature
PN	Pallial nerve
POL	Posterior outer ligament layer
PPR	Posterior pedal retractor muscle or scar
R	Rectum
RC	Right caecum
RM	Radial muscles
S	Shell
SBC	Suprabranchial chamber
SC	Secretory cell
SC(B)	Secretory cell (basiphilic)
SC(E)	Secretory cell (eosinophilic)
SD	Secretory droplet
T	Major typhlosole
U	Umbo
US	Unsolidified style material
V	Ventricle
VG	Ventral marginal food groove
VI	Visceral ganglion
VM	Visceral mass

NOTES ON TWO SPECIES OF RHYTIDID SNAILS FROM LIZARD ISLAND, NORTH QUEENSLAND

by

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SUMMARY

The systematic position, shell, radula, anatomy and habitat preferences and behaviour of two species of rhytidid snails, *Strangesta franklandiensis* (Forbes, 1852) and *Saladelos hobsoni* (Brazier, 1876) found on Lizard Island, North Queensland are described and compared.

INTRODUCTION

During a recent visit to Lizard Island, North Queensland, the land snail fauna was surveyed, the results of which will be published elsewhere. Two species of snails belonging to the family Rhytididae, *Strangesta franklandiensis* (Forbes, 1852) and *Saladelos hobsoni* (Brazier, 1876), were found to be widespread members of that fauna and as the author is at present engaged on a taxonomic revision of the Australian species of this family, it was decided to take the opportunity to carry out detailed observations of the two species.

Unpublished taxonomic information reveals considerable confusion as to the relationships of the Australian species of this family, including these two species. Iredale (1933) erected many new genera and species for this group. He recognised the larger rhytidid on Lizard as a species described by Forbes (1852) but used it as the type species of a new genus, *Murphitella*. The smaller species was given a new specific name and put into a new genus, becoming *Saladelos lacertina* Iredale 1933. Solem (1959) considered *Saladelos* a subgenus of *Delos* Hutton, 1904 and *Murphitella* as a section of subgenus *Rhytida* s.s. Little or nothing is recorded of the anatomy, habitat preferences or behaviour of these species.

The following abbreviations are used:—AM — Australian Museum, Sydney; BM(NH) — British Museum (Natural History), London; NMV — National Museum of Victoria, Melbourne.

SYSTEMATIC SECTION

Genus *Strangesta* Iredale, 1933.

Strangesta Iredale, 1933: 48. Type species: *Helix leichardti* Cox 1864 (= *confusa* Pfeiffer 1855).

Records of The Australian Museum, 1979, Vol. 32 No. 12, 421-434, Figures 1-6.

Synonym: *Murphitella* Iredale, 1933: 49. Type species: *Helix franklandiensis* Forbes 1852.

Shell large, regularly coiled, globose with spire elevated to flat, impressed sutures and deep open umbilicus, aperture large, lunate. Shell thin, fragile with fine, close, transverse sculpture or sculpture absent or replaced by fine spiral lines dorsally, smooth without sculpture ventrally, often glossy. Colour pale yellow to deep honey brown, uniform or with darker transverse bands. Jaw absent. Radula of long, lanceolate recurved teeth, central small, vestigial, laterals grading in size from the centre with largest no more than twice the size of the smallest, 35 to 60 teeth per row. Reproductive system simple, without talon or flagellum; penis with papillae.

The diagnostic characters which separate the genus *Strangesta* from all other rhytidid genera are the large yellow to brown shell with fine sculpture to smooth without sculpture, and the radula structure of lateral teeth grading in size from the centre to the largest tooth no more than twice the size of the smallest having 35 to 60 teeth per row. Within these criteria is a range of species separated by shell shape and colour and differences in radula and anatomical structure.

Iredale (1933) erected the genus *Strangesta* to accommodate the larger rhytidids from Queensland and northern New South Wales, with *Helix leichardti* Cox, 1864 as type species. However, uncharacteristically, he broadened his concept of the genus (Iredale, 1938, 1943) to include the majority of rhytidids of eastern Australia (18 species) from small highly sculptured forms of southern Tasmania to the large Queensland species. Examination of large series of all Australian rhytidids (Smith — unpublished) has led to the conclusion that several generic groupings are present in Iredale's enlarged genus *Strangesta* and this name is here restricted to the large species of Queensland and northern New South Wales for which it was originally erected. Iredale's choice of *H. leichardti* as type species was unfortunate as the type of this species appears to be lost and the species is here considered a synonym of *H. confusa* Pfeiffer, 1855. However, several of the type specimens of nominal species of these large rhytidids are missing and a full description of the genus, and all the species referable to it, will be published elsewhere.

Solem (1959) considered both *Strangesta* and *Murphitella* to be in the subgenus *Rhytida* s.s. Examination of large series of these species (unpublished) suggests that generic differences in shell and radula structure and anatomical features exist between *Rhytida* s.l. and *Strangesta* s.s. Solem separated *Strangesta* sectionally from *Murphitella* because of the loss of the transverse sculpture in the latter group, it being replaced by fine spiral lines. This character here is not considered of more than specific importance in the restricted view of *Strangesta* taken in the present study.

***Strangesta franklandiensis* (Forbes, 1852)**

Figs. 3a,b,c and 5.

Helix franklandiensis Forbes 1852: 379.

Helix (Rhytida) beddomei Brazier 1876: 98.

Helix (Rhytida) jamesi Brazier 1876: 99.

Murphitella froggatti Iredale 1933: 49.

Murphitella franklandiensis Iredale 1933: 49

DIAGNOSIS: Shell large, thin, fragile with flat spire and wide, open umbilicus. Sculpture of fine spiral lines on the dorsal surface, no sculpture ventrally. Aperture wide, lunate. Colour pale yellow to light yellowy green sometimes with occasional dark yellow to green fine transverse bands, with a high gloss on dorsal and ventral surfaces. Radula of long, lanceolate, recurved, unicuspid teeth with small central and lateral teeth increasing in size gradually away from the centre to a maximum at teeth 19 to 23. Rows end with 2-6

DESCRIPTION: The shell is large, thin and glossy with a flat spire, wide deep umbilicus and large lunate aperture. There is no transverse sculpture on the shell but the dorsal surface bears a number of fine spiral lines. The ventral surface of the shell is smooth and glossy without sculpture. The colour varies from pale yellow to greeny yellow and often bears fine transverse bands of darker colour either yellow or green.

The body is light creamy yellow in colour with dark optic tentacles and a prominent white stripe down the mid-dorsal line of the head and body. This stripe is lost in preserved specimens but is reflected in a wide continuous mid-dorsal skin tubercle band, the remainder of the body bearing large tubercles.

The genital opening is displaced posteriad on the right side to just in front of the pneumopore. This is a result of the greatly enlarged buccal mass. The everted penis is a short simple organ with the surface covered with short papillae. All the preserved specimens available for study proved to be very immature with regard to reproductive tract maturation, even from 4½ whorl shells exceeding 20 mm diameter. An examination of the collecting data revealed that they were all collected in the dry season from June to early December. This region of North Queensland has distinct wet and dry seasons and it is suspected that reproductive maturation is closely correlated with the wet season, reproductively mature animals only being present in the populations some time after the onset of the wet season. Because of the lack of suitable material no detailed description of the reproductive tract is possible. The reproductive tract appears to be simple, though a small verge may be present. The spermatheca has a long duct and is situated at the distal end of the common duct. The hermaphrodite gland, embedded in the digestive gland in the apical whorls, consists of a series of finger-like processes from a branching duct.

TYPE MATERIAL: Lectotype of *H. franklandiensis* here designated, in British Museum, BM(NH) 1859.3.11.4 from Frankland Island. Dimensions: max. dia. 15.1 mm; min. dia. 12.4 mm; height 5.7 mm. Two paralectotypes, BM(NH) 1859.3.11.3 from Lizard Island. Dimensions of largest specimen: max. dia. 25.5 mm; min. dia. 21.2 mm; height 8.34 mm.

H. (R.) beddomei Brazier — 10 syntypes, AM C87297.

H. (R.) jamesi Brazier — 1 syntype, AM C11107; 4 syntypes, AM C87293.

M. froggatti Iredale — 2 syntypes, AM C87295.

TYPE LOCALITY: Frankland and Lizard Islands, North Queensland, about the roots of trees.

DISTRIBUTION: The species is confined to the coastal region and slopes of the Great Dividing Range of North Queensland, the southern limit being in the Townsville area. However, comparatively little collecting has been done away from the few "classical" localities in North Queensland and more widespread collecting could extend its range. In an attempt to smooth out the patchiness of the distribution the known localities have been drawn on a 30 minute grid map (Fig. 1.).

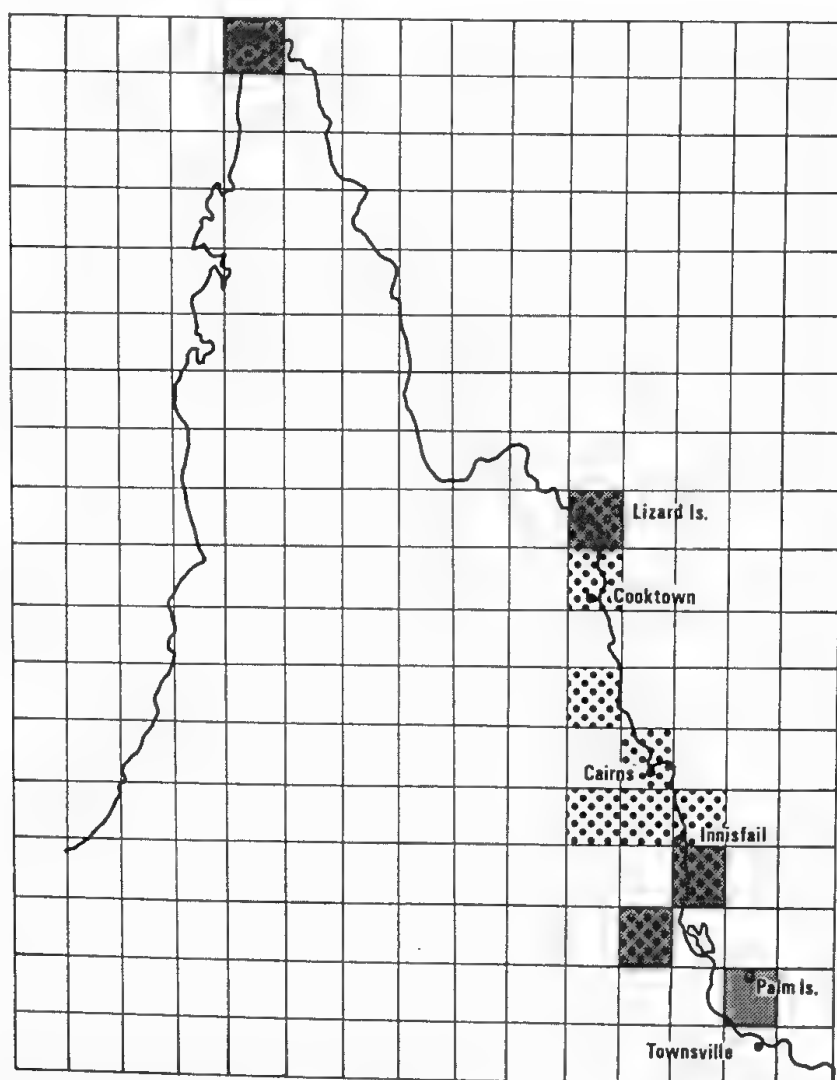


Fig. 1. Map of North Queensland showing the distribution of *Strangesta franklandiensis* (large dots) and *Saladelos hobsoni* (grey stipling) on a 30 minute map grid.

A detailed distribution of the species on Lizard Island will be given elsewhere. It was found in the dry woodland areas only occasionally being found in the broadleaf rainforest patches. The collecting sites where this species was found on the Lizard Island and adjacent islands survey are numbers 4, 5, 7, 8, 12, 13, 16, 18, 19, 25, 27, 28.

ECOLOGICAL NOTES: As stated above, the species was originally found "about the roots of trees". Before the wet season started on Lizard Island, live specimens were found buried 10-40 mm in the soil under roots and stones in sheltered places in the dry scrub areas of the island. Only occasional specimens were found in the broadleaf rainforest patches in the steep gullies on the island and these specimens were only found close to the edges of these patches.

When the wet season broke on the island, at night during or after rain, the snail was found crawling on the ground surface. It was found associated with the large camaenid, *Hadra semicastanea*, which probably forms the principal food of *Strangesta franklandiensis*, as once the wet season had commenced the *Strangesta* were observed feeding on the *Hadra* many times at night. The populations of *Hadra* appeared to outnumber by many times the populations of *Strangesta* in any given area.

Feeding took place with the *Strangesta* inserting its long head inside the aperture of the camaenid. On separating the snails it was evident that the body wall of the camaenid had been severely ruptured as large portions of viscera were seen exposed in the aperture of the shell. Limited feeding experiments were attempted in the laboratory to obtain more precise observations but the snails did not feed. On one occasion a small specimen of *Strangesta* was observed feeding on a specimen of *Saladelos hobsoni* (J. B. Burch — pers. comm).

REMARKS: *Strangesta franklandiensis* is characterized by its large glossy shell with flat spire, and with the typical transverse sculpture of many members of the genus replaced by fine spiral lines. It is placed in the genus *Strangesta* because of the close similarities with other large rhytidids in Queensland in shell and radula structure. It is separated from all other *Strangesta* species by its flat glossy yellow to greeny-yellow shell without fine transverse sculpture. *H. (R.) beddomei*, *H. (R.) jamesi* and *M. froggatti* are here considered synonyms as they all fall within the species limits of this species. *H. beddomei* from Albany Island off Cape York, *H. jamesi* from Palm Island and *M. froggatti* from Cairns represent local variations in shell shape and colour pattern within the species.

Genus *Saladelos* Iredale, 1933.

Saladelos Iredale, 1933: 48. Type species: *Saladelos commixta* Iredale 1933 (= *hobsoni* Brazier 1876).

Shell small, thin, with whorls rapidly increasing in size, spire flat, sutures impressed, umbilicus wide, body whorl rounded, aperture ovate. Sculpture of fine, simple, transverse striae to smooth on dorsal surface, ventral surface smooth. Colour uniform yellow to dark honey to greeny-yellow, no colour pattern. Radula of long, pointed peg-like teeth, rhachidian and centrals small, large laterals grading to the centrals and to small outside teeth, 30 to 50 teeth per row. Reproductive system simple, penis with small papillae.

The diagnostic characters which separate the genus *Saladelos* from all other rhytidid genera are the small flat yellow to honey shell without colour pattern and with a wide open umbilicus and weak transverse striae, and the radula structure of peg-like teeth.

Iredale (1933) erected the genus *Saladelos* to accommodate the small, flat yellow rhytidids which inhabit the broadleaf rainforest litter in the coastal region of Queensland and northern New South Wales. He recognised that the earliest specific name referable to this group, *Helix splendidula*, Pfeiffer 1846 was preoccupied by a Gmelin (1791) name and therefore erected a new name, *Saladelos commixta* Iredale 1933 for this species. This species was also created type species of the new genus. Unfortunately this is not now the earliest valid name for the suite of "Iredalean species" in North Queensland here considered to be one species. By synonymy, the type species must revert to the earliest name, *Helix (Rhytida) hobsoni* Brazier, 1876, the reasons for which are set out below.

Solem (1959) considered *Saladelos* to be a subgenus of *Delos* Hutton 1904 on gross similarities of sculpture and whorl increment and because, until fuller information was available, he considered such grouping to be in the interest of better broad understanding of the fauna. The contrary view is taken here that such amalgamation is too extreme a step on comparatively little evidence as it could obscure true relationships by channelling thought and is especially prone to possible mis-association by including convergent groups into a single higher taxon grouping. The status of the genus *Saladelos* and its relationship to *Delos* and the other groups associated with it by Solem will be published elsewhere. *Saladelos* is separated from these other groups by the sculpture of fine transverse striae and by the uniform colour of the shell with no colour pattern. The radula is composed of short, pointed, peg-shaped teeth with about half the teeth per row being large, wide teeth. Various anatomical and ecological factors, described below, give rise to doubts as to whether species of *Saladelos* still adhere to the primary carnivorous habit of the family. However, its position in the family Rhytididae is assured by its agnathous condition, the long, lanceolate unicuspid teeth and simple reproductive system with papillate penis.

***Saladelos hobsoni* Brazier, 1876.**

Figs. 2, 4a, b, c, and 6a, b.

Helix splendidula Pfeiffer 1846: 128. Not *H. splendidula* Gmelin, 1791: 3655

Helix (Rhytida) hobsoni Brazier 1876: 99

Saladelos commixta Iredale 1933: 48 nom. nov. for *H. splendidula* Pfr.

Saladelos commixta lacertina Iredale 1933: 48

Saladelos commixta bensa Iredale 1933: 48

Saladelos hobsoni Iredale 1938: 117

DIAGNOSIS: Shell small with rapidly increasing whorls, impressed sutures and rounded shell margin, spire flat to slightly elevated, umbilicus wide and deep, whorls

open, aperture ovate-lunate. Sculpture of very fine transverse striae, occasionally with suggestion of spiral lines, ventral surface smooth. Colour usual uniform with no pattern or occasional thin darker transverse bands, yellow to honey yellow. Radula of long peg-like teeth, small central teeth, increasing in size from the centre with teeth 9-14 each side twice as large as inner laterals, few vestigial teeth towards margin, (16-18)—1—(16-18) teeth per row. Penis uniformly covered with widely spaced small papillae.

DESCRIPTION: The shell is small, $4\frac{1}{2}$ whorls, with rapidly increasing whorls, impressed sutures and a rounded shell margin. The spire is flat or slightly raised and the umbilicus is wide, deep and open. The aperture is large and ovate-lunate. Sculpture consists of very fine transverse striae with the occasional suggestion of fine spiral lines. The ventral surface is smooth and glossy except for growth lines. The colour is a uniform yellow to honey with no pattern or only occasional dark yellow to green fine transverse bands.

When crawling the animal appears small with the head only protruding about a third of a shell diameter in front of the shell. The tentacles are short and the shell is carried at an angle to the ground or vertical. The importance of this shell carriage position is explained below. No ventral sensory appendages were noticed below the lower pair of tentacles and skin tuberculation is very light and sparse. The body colour is cream to light brown with darker bands of colour showing through the body wall in the position of the optic tentacle retractor muscles. A wide light mid dorsal stripe is seen in some individuals with a few showing two fine light mid dorsal stripes with a dark brown line between them.

The radula consists of a series of long peg-like teeth with a radula formula of (16-18)—1—(16-18) teeth per row (Fig. 6a, b.). The central tooth is small to vestigial. From the centre the teeth increase slowly in size until the 9th, which is about twice the size of the inner teeth. Teeth 9 to 14 are approximately equal in size. From 14 there is a sharp reduction in size to small to vestigial outer laterals. No articulation could be seen between the base plates of adjacent rows.

The buccal mass is small, only occupying the anterior part of the head cavity and is elongate-ovate in shape, not a long cylindrical muscular organ. The central nerve ring surrounds the posterior part of the buccal mass and the oesophagus arises from the dorso-posterior side.

The genital aperture is situated on the right side of the body and is displaced posteriad close to the pneumopore. In a relaxed specimen, where the penis has everted, the penis is long and sparsely covered with small papillae. There is also a large penis sheath expansion. Specimens were found at the commencement of the wet season (December) with well developed reproductive tracts. The reproductive system is simple with no flagellum or extra penial or genital appendages or verge (Fig. 2.). A large epiphallus, equal in size to the penis occurs between the penis and the vas deferens. The prostate gland consists of a series of densely convoluted tubules forming a compact gland at the proximal end of the common duct with an elongated process distally almost to the junction with the albumen gland. The spermatheca is a small simple sac with a long duct the entire length of the common duct. The spermatheca occurs close to the junction of the common duct and albumen gland. The albumen gland is small and dark yellow in colour. The hermaphrodite gland occurs in the top whorls embedded in the digestive gland. It has a similar form to that found in *Strangesta* being made up of several finger-like lobes projecting from a branching duct.

TYPE MATERIAL: Lectotype of *H. (R.) hobsoni* here designated in Australian Museum, AM C87294 from Palm Island, N. Queensland. Dimensions: max. dia. 9.6 mm; min. dia. 7.7 mm; height 5.05 mm. One paralectotype, AM C106020. Dimensions: max. dia. 8.3 mm; min. dia. 6.19 mm; height 4.5 mm.

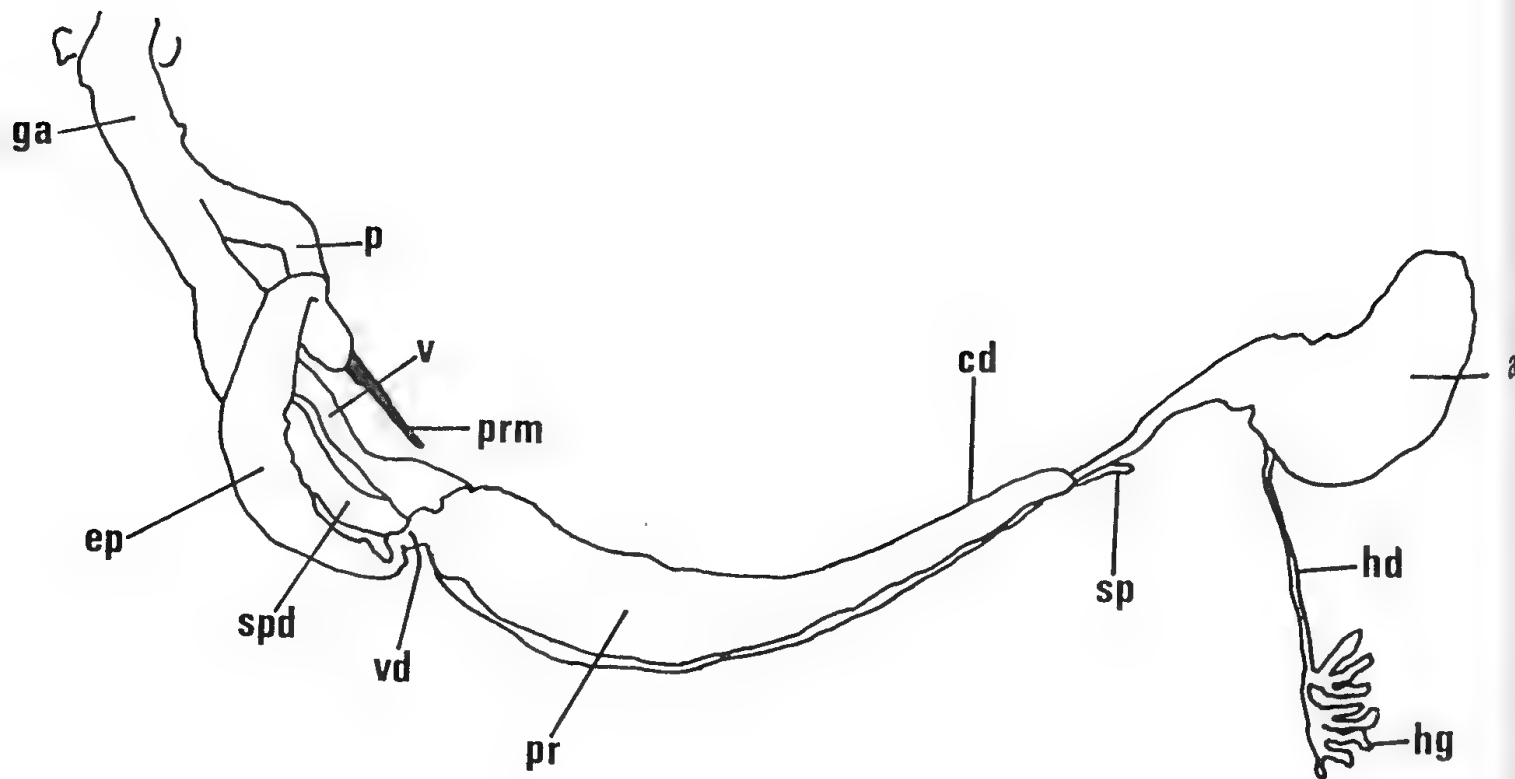


Fig. 2. Diagram of the reproductive tract of *Saladelos hobsoni*. Abbreviations: ag — albumen gland; cd — common duct; ep — epiphallus; ga — genital atrium; hd — hermaphrodite duct; hg — hermaphrodite gland; p — penis; pr — prostate gland; prm — penal retractor muscle; sp — spermatheca; spd — spermathecal duct; v — vagina; vd — vas deferens.

The original description of the species (Brazier, 1876) states that ten specimens were found when the type series was collected. The whereabouts of the other eight specimens (paralectotypes) is not known.

Because *S. commixta* was a new name for *H. splendidula* Pfr. 1846, the type specimen involved is that of the latter name. The type of *H. splendidula* is thought to have been lodged in the British Museum (Natural History) but no types were found on a recent search. Their collections do contain specimens bearing that name from the Cuming Collection from Cape York with the collector named as MacGillivray. This differs from the original description from "Eastern Australia, near Torres Strait (Lieut. Ince, R.N.)." Until more information regarding the types can be brought to light they should be considered lost.

S. commixta lacertina Iredale — 5 syntypes, AM C87300
S. commixta bensa Iredale — 5 syntypes, AM C87299

TYPE LOCALITY: Palm Island, North Queensland.

DISTRIBUTION: The species is confined to the coastal region and off-shore islands of North Queensland from a southern limit of its type locality on Palm Island between Townsville and Tully to islands off Cape York on Torres Strait. However, it is only known from a very few localities (under 10) and the distribution is shown (Fig. 1.) on a 30 minute grid map in an attempt to even out the collection bias.

A detailed distribution of the species on Lizard Island will be given elsewhere. It was found confined to the patches of broadleaf rainforest found in the gullies on the island. The collecting sites where this species was found on the Lizard Island and adjacent islands survey are numbers 1, 6, 7, 12, 15, 16, 17, 18, 19, 20, 21, 22, 23, 27, 28.

ECOLOGICAL NOTES: On Lizard Island the species is confined to the leaf litter of the broadleaf rainforest patches and is found in association with *Theskelomensor lizardensis* (Pfeiffer, 1863) an aberrant helicarionid (Solem 1958), the helicimid *Helicina gouldiana*, two species of pupinid and a species of microcystid. However, in many individual collections *S. hobsoni* was one of the most abundant snail species found, in some collections making up 50% of all snails collected. This finding is in conflict with the general premise that carnivores are usually greatly outnumbered by their prey in any population assemblage. This in turn throws grave doubt on the assumption that *S. hobsoni* (in common with most other Australian rhytidids) feeds mainly on other species of snails and even brings into question whether *S. hobsoni*, and by inference the other species of the genus *Saladelos*, are carnivorous in habit or whether they have secondarily reverted to vegetable food. This hypothesis is further supported by the relative size of the buccal mass and head region, by the mode of carriage of the shell and by initial field and laboratory observations.

The shells of this species are carried in the near vertical position with the spire on the right side. The animal is small compared to the shell size and when crawling only protrudes from the shell about a third to a half of the shell diameter. The buccal mass is also small, occupying only the anterior third of the expanded head region. This is in sharp contrast to the body and buccal mass sizes of most other Australian rhytidids. These differences support the hypothesis that this species does not require a large muscular buccal mass or long head to follow prey into shell apertures or down burrows or crevices and does not ingest large prey which might be taking avoiding action. Though specimens were observed in the field in conditions where feeding could have been expected to occur (wet days when *Strangesta franklandiensis* close by was observed feeding) no feeding by this species was observed. Individuals of this species were confined with other snail species from the same locality and no feeding or evidence of feeding was observed.

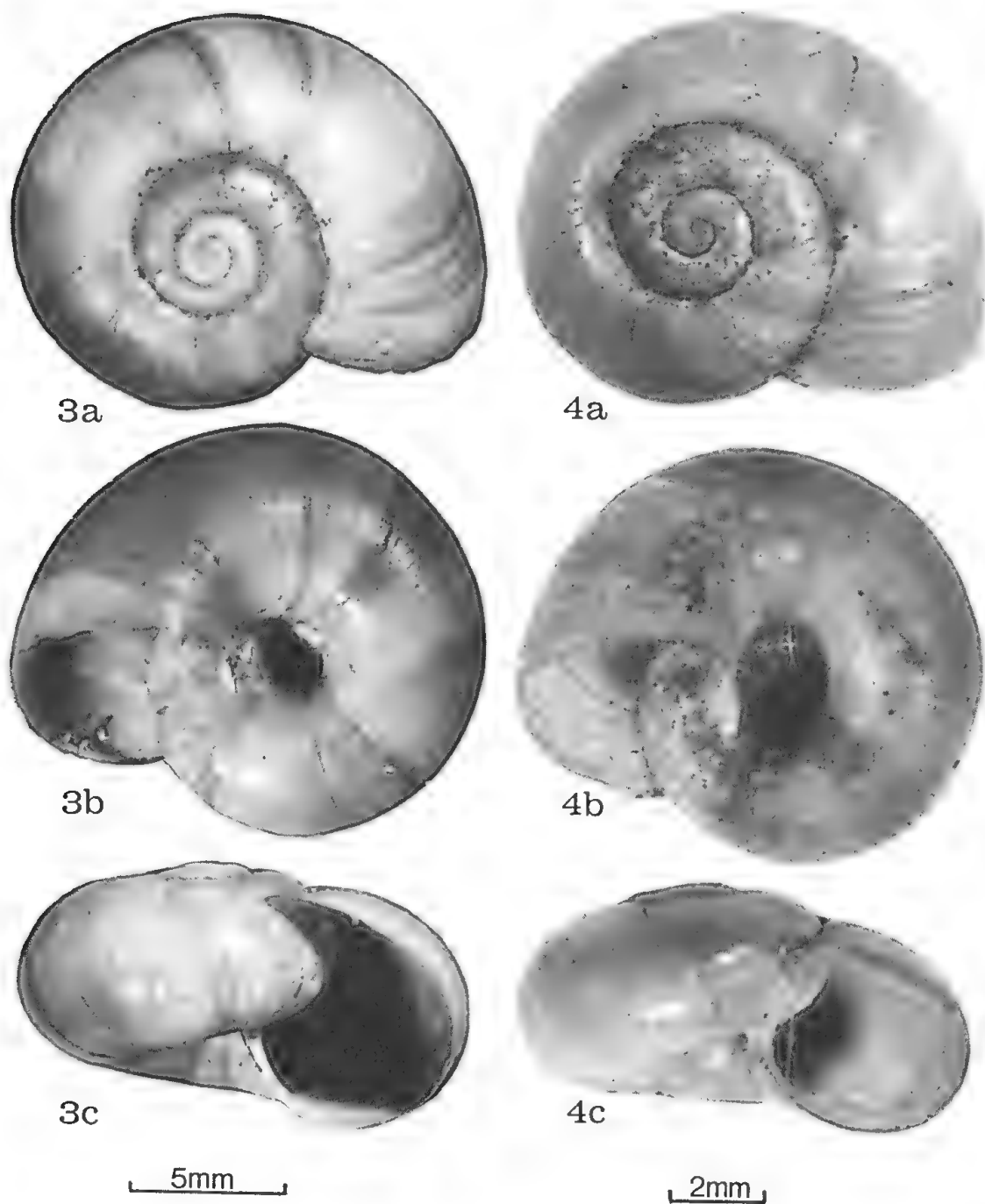
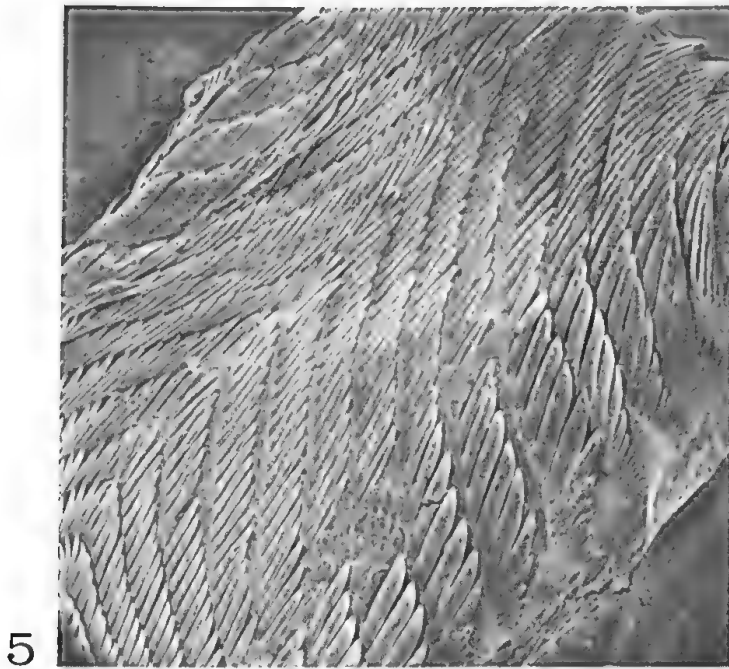
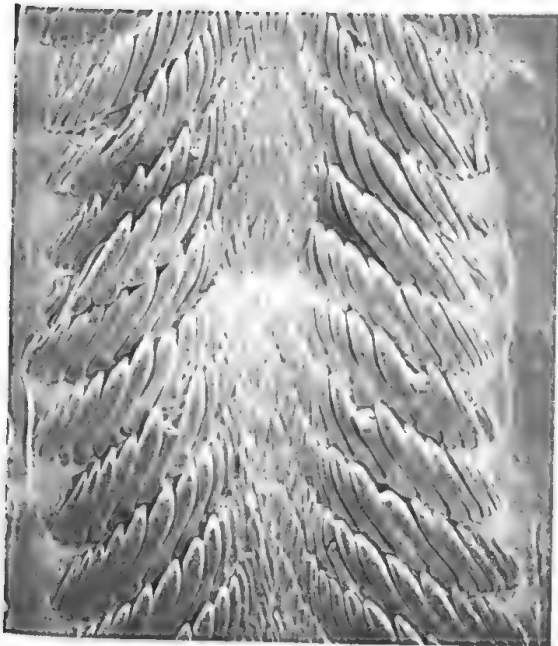


Fig. 3. Photographs of the (a) dorsal, (b) ventral and (c) aperture views of the lectotype of *Strangesta franklandiensis*, BM(NH), 1859.3.11.4.

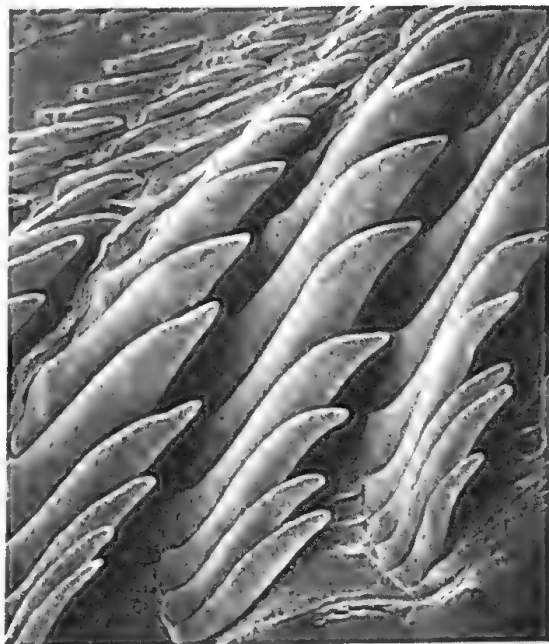
Fig. 4. Photographs of the (a) dorsal, (b) ventral and (c) aperture views of the lectotype of *Saladelos hobsoni*, AM, C87294.



5



6a



6b

Fig. 5. Scanning Electron Microscope photograph of the radula of *Strangesta franklandiensis* — X30.

Fig. 6. Scanning Electron Microscope photographs of the radula of *Saladelos hobsoni*, (a) showing general structure — X136; (b) showing detail of tooth structure — X420.

During field work the habitat of this species was examined for other possible prey animals which might occur in sufficient numbers in these localities to support the populations of *S. hobsoni* found. No such aggregations of any likely prey species were found. However, the habitat consisted of rotting leaf litter and decaying branches in which occurred large slime mould complexes. No evidence of any food preference was found but it is felt possibly that *Saladelos hobsoni* on Lizard Island may not be carnivorous but may be secondarily herbivorous in habit.

REMARKS: *Saladelos hobsoni* is characterised by its small, flat, light to dark yellow, unicoloured shell with fine transverse sculpture, rounded lateral margin and wide umbilicus. Its small animal and vertical mode of shell carriage easily separate it from other North Queensland rhytidids. *S. commixta commixta* from the islands of Torres Strait, *S. commixta lacertina* from Lizard Island and *S. commixta bensa* from Ben Lomond, Port Denison are all here considered synonyms of this species as they only differ marginally in shell colour and in umbilicus size. Examination of the types of these species shows them to fall within the species limits of *Saladelos hobsoni*.

DISCUSSION

The visit to Lizard Island provided an opportunity to look at two dissimilar species of the same family, the Rhytididae, inhabiting a comparatively small island several kilometres off the coast. Most museum collections would simply record the locality as Lizard Island and it is only in the past few years that brief habitat data have also been routinely recorded with such material. This study emphasises the need for habitat details to be recorded in order to make maximum use of the material.

The two rhytidid species found on Lizard Island, *Strangesta franklandiensis* and *Saladelos hobsoni*, occupy different ecological niches with very little overlap in habitat requirements. Both species occur along the coastal strip and off-shore islands of North Queensland, though their exact distribution range is not known through lack of extensive collecting. There appears to be a parallel series of large and small rhytidids occurring down the coast of eastern Australia of which the two species in this present study form the northernmost representatives.

Strangesta franklandiensis appears to be an important predator of the large camaenid *Hadra semicastanea* which in turn is probably the main food-source for the rhytidid. These two snails are found over much of the island, but do not appear to penetrate far into the broadleaf vine-forest patches. *Saladelos hobsoni* is confined to this latter habitat where it is often found in large numbers. It is not known what food preference this snail possesses but it is thought probable that it may be secondarily herbivorous or fungivorous rather than carnivorous as most of the family appears to be.

ACKNOWLEDGEMENTS

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A REVISION OF QUEENSLAND LITHOPHAGINE MUSSELS 435 (BIVALVIA, MYTILIDAE, LITHOPHAGINAE)

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INTRODUCTION

Among mytilid bivalves, boring in coral or calcareous rocks has evolved as one of the major life styles. Current nomenclature distributes the species of boring mytilids among the "genera" *Lithophaga* Roding, 1798, *Adula* Adams and Adams, 1857, and *Botula* Mörch, 1853, but there is little agreement on the subdivisions and relationships of these major groups.

A preliminary survey shows that there are about a dozen species of *Lithophaga* in the Indo-West Pacific Region but their nomenclature is confused and their distribution uncertain. Data are presented in this paper on the nomenclature, morphology, ecology and distribution of the species of *Lithophaga* found on the Great Barrier Reef.

The work began in September 1970 when I visited Heron I., Michaelmas Cay, Low Isles and other Queensland localities, and continued when I participated in the malacological workshop meeting at Lizard I. in December 1975. The anatomical data are based primarily on specimens collected at Lizard I. except where indicated otherwise. I have also collected these mussels at many other areas of Western Australia, S.E. Asia and the western Pacific and these specimens have provided a helpful source of comparative material. In particular I was able to study in detail the anatomy and ecological distribution of lithophagines at Kendrew I., Dampier Archipelago, during a study of the Crown of Thorns Starfish there in the years 1972-1974, and at Malaupaina I., Solomon Islands while I was the guest of Dr Walter Starck aboard the vessel "El Torito" in October-November, 1975.

MATERIALS AND METHODS

Specimens were studied anatomically either alive or after preservation in 10% formaldehyde. Dissections were done under a binocular microscope and drawings were done free-hand. In the anatomical notes the general organisation of mytilids is assumed to be understood (see List, 1902; Field 1922; White, 1937; Wilson, 1967; Yonge, 1976) and only those characters of interest and significance to the taxonomy of lithophagids in particular are described. The anatomy of *L. teres* is described in most detail. For the other species only those characters considered to differ significantly are indicated; other anatomical characters may be assumed to have been examined and found to be not significantly different to *L. teres*.

Locality records are based principally on the collections of the Western Australian Museum and the Australian Museum, although occasionally adequately illustrated literature records are referred to. All the anatomical material examined is now preserved and catalogued in the Western Australian Museum.

Shell parameters measured are illustrated in Fig. 1.

Abbreviations:

AM	Australian Museum (Sydney)
WAM	Western Australian Museum
BM (NH)	British Museum (Natural History)
MNHN (Paris)	National Museum of Natural History (Paris)
MNHN (Santiago)	Museum National History Natural (Santiago)

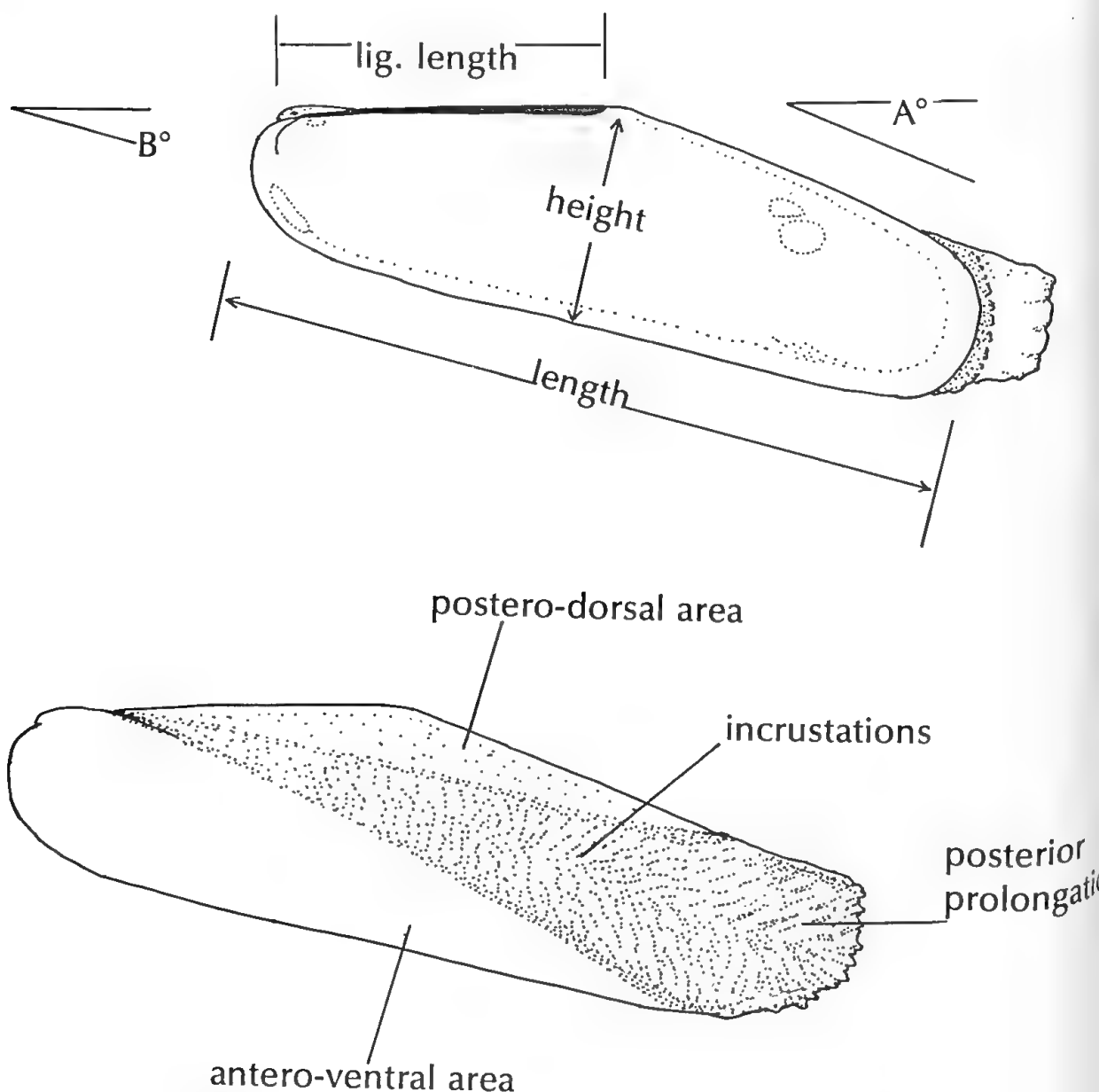
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WA
QLD
NSW

Western Australia
Queensland
New South Wales

TAXONOMIC BACKGROUND

Carpenter (1856), Fisher (1886) and Dall (1898, 1916) introduced a series of genus-level names for American lithophagines and these names are in current use (see Turner and Boss, 1962, Soot-Ryen, 1955, 1969, Olsson, 1961). Iredale (1939) reviewed the taxa and their diagnostic characters but ignored the possibility that some of them might also be represented in the Indo-West Pacific region and proposed a new series of sectional names for lithophagines from Queensland.



Figs. 1a & 1b. Diagrammatic illustration of the parts of a lithophagid shell.

Soot-Ryen (1969) attempted to reconcile these two systems. Referring only to shell characters he synonymised all but one of Iredale's "sections" with American counterparts and treated all the senior synonyms as sub-genera of *Lithophaga*. The New Zealand borer *Zelithophaga* Finlay, 1927 and the tropical West Coast American borer *Stumpiella* Soot-Ryen, 1955 were also treated as subgenera of *Lithophaga* by Soot-Ryen. *Adula* was treated as a distinct genus (not represented in the Indo-West Pacific Region) and placed with *Lithophaga* in a subfamily Lithophaginae, Adams and Adams, 1857. Soot-Ryen regarded *Botula* as unrelated and belonging to the subfamily Modiolinae Keen, 1958.

It follows that, according to this system, all the lithophagids of the Indo-West Pacific belong to the genus *Lithophaga*.

The subgenera of *Lithophaga* recognized in the Treatise by Soot-Ryen (1969) may be summarized as follows:

LITHOPHAGA s.s. Röding 1798.

type species: *Mytilus lithophagus* Linné, 1758.

LEIOSOLENUM Carpenter, 1856

type species: *Leiosolenus spatiosus* Carpenter, 1856.

MYOFORCEPS Fisher, 1886.

type species: *Modiola caudigera* Lamarck, 1819.

DIBERUS Dall, 1898.

type species: *Modiola plumula* Hanley, 1843.

= EXODIBERUS Iredale, 1939.

type species: *Lithophaga calcifer* Iredale, 1939.

= SALEBROLABIS Iredale, 1939.

type species: *Lithophaga divaricalx* Iredale, 1939.

LABIS Dall, 1916.

type species: *Modiola attenuata* Deshayes, 1836.

= *Doliolabis* Iredale, 1939.

type species: *Lithophaga laevigata instigans* Iredale, 1939.

MYAPALMULA Iredale, 1939

type species: *Lithophaga dichroa* Iredale, 1939.

STUMPIELLA Soot-Ryen, 1955.

type species: *Lithophagus calyculatus* Carpenter, 1856.

ZELITHOPHAGA Finlay, 1927.

type species: *Lithodomus trunculus* Gray, 1843.

Otter (1937) published a study of the boring molluscs at Low Isles resulting from his work during the 1928-29 Great Barrier Reef Expedition. He described the habitats and burrows of 4 species of *Lithophaga* under the names *teres*, *obesa*, *hanleyana* and *cumingiana*. The first and second of these were correctly identified but under the name *hanleyana* it now appears that Otter confused 4 species and under the name *cumingiana* he confused 2 species. As a consequence his ecological results are now difficult to interpret.

Iredale (1939) published a taxonomic account of the Great Barrier Reef Expedition lithophagid material. He listed the names that had been previously "cited in the Australian connection" but failed to indicate which of these he regarded as representing lithophagids living in Australian waters. Instead he directed his attentions to the Otter material and some other recently collected specimens. As usual his practised eye correctly recognized

Name used here	Iredale	Otter	Gohar and Soliman
<i>hanleyana</i>	<i>laevigata instigans</i>	<i>hanleyana</i> (part)	<i>hanleyana</i>
<i>lessepsiana</i>	<i>simplex</i>	<i>hanleyana</i> (part)*	<i>cumingiana</i>
<i>malaccana</i>	<i>calcifer</i>	<i>hanleyana</i> (part)	<i>laevigata</i>
<i>divaricalx</i>	<i>divaricalx</i>	<i>hanleyana</i> (part)	—
<i>nasuta</i>	<i>dichroa</i> (part)	<i>cumingiana</i> (part)	—
<i>lima</i>	<i>dichroa</i> (part)	<i>cumingiana</i> (part)	<i>lima</i> (?)
<i>teres</i>	<i>teres annectans</i>	<i>teres</i>	—
<i>obesa</i>	<i>obesa suspecta</i>	<i>obesa</i>	—

Table I. Showing the probable equivalence of names used by Iredale (1939), Otter (1937) and Gohar & Soliman (1969 a & b) with those used in this paper.

most of the species entities involved. He introduced 4 new species names and 3 new subspecies names to account for the 7 species he recognized in the material but failed to indicate clearly how his new names related to Otter's groupings.

In 1970, through the generous help of Mr Ed Kels with his vessel 'Paladin', I visited Low Isles and collected toponotypic series of specimens of Iredale's taxa. From these and other Queensland specimens I have concluded that the 7 species entities recognized by Iredale can be substantiated though there was one other in Otter's material which he did not account for. The question of nomenclature is another matter; all but one of Iredale's new names may be relegated to synonymy. Thus there are 8 species of *Lithophaga* at Low Isles, and these appear to be widely distributed in the Indo-west Pacific Region. They comprise the bulk of the Queensland lithophagid fauna. The only addition I am able to make to this list is *L. antillarum*, an uncommon species from the southern part of the Great Barrier Reef. The senior synonyms and their equivalent Iredale and Otter names, as far as I can determine, are given in Table I.

Gohar and Soliman (1969 a&b) described the habitats, burrows and morphology of 4 species of *Lithophaga* from the Red Sea (plus 1 species of the apparently unrelated genus *Botula*). So that their data may be related to mine I have included their names in Table I, basing my conclusions solely on my own interpretation of their descriptions.

KEY TO THE SPECIES OF QUEENSLAND LITHOPHAGINES BASED ON SHELL CHARACTERS

1. Shell surface sculptured, lacking superficial calcareous incrustations 2
 - Shell surface smooth but may bear superficial calcareous incrustations which may be sculptured 3
2. Sculpture of irregular, wavy, near vertical cords confined to antero-ventral area *teres*
 - Sculpture of irregular, wavy, near vertical cords antero-ventrally plus chevron-shaped cords postero-dorsally *antillarum*

3. Shell with thick superficial calcareous incrustations postero-dorsally which project well beyond posterior end..... 4
 Shell without superficial calcareous incrustations postero-dorsally, or if present these are thin and do not project far beyond the posterior end 7
4. Postero-dorsal incrustations smooth, projecting posterior ends squared and chisel-edged*hanleyana*
 Postero-dorsal incrustations strongly sculptured, projecting posterior ends irregular, rounded or dentate 6
6. Postero-dorsal incrustations pitted or irregularly lamellose, postero-dorsal angle low (i.e. 31-35°)*malaccana*
 Postero-dorsal incrustations cast into high chevron-shaped lamellae, postero-dorsal angle high (i.e. 35-40°)*divaricalx*
7. Shell and periostracum uniformly coloured 8
 Shell or periostracum with a conspicuous dark brown or purplish radial ray 9
8. Shell large (to 11cm length), elongate — ovate, antero-ventral area with a continuous smooth or granular superficial calcareous coating.....*obesa*
 Shell small (to 3cm length), elongate — cylindrical, antero-ventral area lacking a superficial calcareous coating.....*lessepsiana*
9. Shell uniform off-white, periostracum light brown with a conspicuous darker brown to purplish radial umbonal ray*nasuta*
 Shell off-white with a conspicuous purple radial umbonal ray visible beneath a uniform olive-brown periostracum.....*lima*

TAXONOMY

Lithophaga teres (Philippi, 1846)

; (Fig. 16 (1-3); text figs. 2-4)

Modiola teres Philippi, 1846: 148, pl. 1, fig. 3. Type locality: Pacific Ocean. Type: MNHN, Santiago, Chile (pers. comm. K. Kleeman).*Modiola malayana* Philippi, 1847a: 117. Type locality: China Sea, Sulu Island etc. Type: MNHN, Santiago, Chile (pers. comm. K. Kleeman).*Modiola gracilis* Philippi, 1847b: 19. pl. 2, fig. 1. Type locality: China. Type: MNHN, Santiago, Chile (pers. comm. K. Kleeman).*Dactylus erythraensis* Jousseaume, 1888: 218-219. Type locality: Obock, Red Sea. Syntypes: MNHN (Paris).*Lithophaga teres annectans* Iredale, 1939: 422, pl. 6, fig. 29. Type locality: Low Isles, Qld. Holotype: AM regn. no. C60406; plus 9 paratypes, AM regn. no. C63285.

DISTRIBUTION: This is one of the most widely distributed species in the genus ranging throughout the tropical Indian and Western Pacific Oceans. In W.A. it penetrates far south into temperate waters being recorded off Albany on the south coast. In Qld. it is known from at least as far south as the Capricorn Group. Queensland localities are: Thursday I., Murray I., Lizard I., Low Isles, Michaelmas Cay, Innisfail, Townsville, Dunk I., Bowen, McKay, Port Curtis, Keppel Is., Lindeman I., Port Molle, Hayman I., Masthead I., Heron I., Swain Reefs.

HABITAT: Bores in dead coral or lithothamnion at depths from the intertidal zone to at least 66 metres. Though sometimes found burrowing in living massive coral heads (e.g. *Favia*) the burrow opening is always located in a position where there are no living polyps.

DESCRIPTION: SHELL: Moderately strong; elongate-elliptical, smooth postero-dorsally but sculptured antero-ventrally by conspicuous, crowded, vertical, parallel cords. Interior iridescent, exterior whitish but covered with a thick, smooth, dark-brown to almost black periostracum. Umbos sub-terminal; anterior and posterior ends rather sharply rounded; ventral margin straight or slightly convex; antero-dorsal margin (hinge-line) almost half the length of the shell, slightly convex; postero-dorsal margin straight; dorsal angle weak and low.

There are no superficial calcareous incrustations but the posterior margins are sometimes thickened and lip-like, presumably forming a plug to block the burrow mouth and serving the same function as the thick posterior accretions of some other species. In older specimens successive phases of thickened posterior margins are often recorded as a series of thick concentric growth ridges.

Dimensions: The largest specimen in the WAM and AM collections is 7.52cm long. Dimensions of Low Is. and Red Sea specimens are given in Table 2.

ANATOMY: (see also Pelseneer, 1911: 20-21, pl. 7, fig. 1)

The anterior adductor muscle is elongate, narrow, and lies along the antero-ventral shell margin. The posterior adductor is small and ovate. Anterior retractors are narrow and attach directly below the umbos; posterior retractors are wide, compressed, undivided and attach above the posterior adductor. The left and right posterior retractors adhere together closely ventrally but diverge dorsally with a deep V-shaped space between them. Small siphonal (pallial) retractors are developed at the ventral margin some distance anterior to the position of the posterior adductor (Fig. 2).

The free edges of the mantle lobes possess inner, middle and outer folds as in other mytilids. The mantle lobes are fused postero-dorsally (i.e. between the postero-dorsal angle and the posterior end of the shell) and antero-ventrally behind the anterior adductor; they are not fused postero-ventrally but are joined together at the posterior end by a muscular membrane, the branchial septum, thus separating the posterior excurrent aperture from the postero-ventral incurrent aperture. In this posterior region the inner folds of the mantle lobes are thickened, muscular and capable of extension to form excurrent (dorsal) and incurrent (ventral) siphons. The dorsal excurrent siphon is tubular; the ventral incurrent siphon is merely a deep fold which gapes ventrally (Fig. 2).

The branchial septum bears a muscular curtain-like partition descending obliquely from its anterior margin to partially occlude the inner end of the incurrent siphon (Figs. 2 & 3). The partition is concave with the concavity facing the rear. Its edge is smooth except in the lateral corners where there are 1-3 small papillae. In addition there are usually 1 or 2 larger simple or branched papillae on the mantle lobes themselves adjacent to the junction of the septal partition (Fig. 3).

Table 2.

Dimensions of *L. teres* (in mm).

	length	height	width	lig. length	A°	B°
<i>LOW IS. (Type series <i>L. teres annectans</i>)</i>						
Holotype	63.8	17.6	14.9	32.8	18°	12°
Paratypes	62.8	16.3	14.4	—	—	—
	45.7	13.9	11.4	—	—	—
	50.8	12.8	11.1	—	—	—
	40.1	10.9	08.8	—	—	—
	36.8	11.9	10.0	—	—	—
	32.0	09.7	08.3	—	—	—
	27.1	07.8	07.1	—	—	—
	24.5	01.8	06.4	—	—	—
	22.1	06.0	07.1	—	—	—
<i>RED SEA</i>						
(Syntype series <i>L. erythraensis</i>)	54.2	14.0	11.9	21.4	16°	15°
	41.8	11.0	—	16.2	14°	11°
	41.9	11.6	10.5	18.6	13°	11°
	40.8	11.4	11.0	18.4	15°	10°
	59.1	15.5	06.9	21.6	15°	13°
	62.3	16.6	13.1	24.0	16°	9°
	29.2	08.2	06.8	10.8	15°	8°
	29.1	07.0	05.7	12.0	11°	5°
	30.0	07.1	05.9	11.9	11°	6°
	28.5	07.2	06.2	11.1	15°	8°
	23.7	06.3	05.4	11.3	12°	5°
	20.5	05.9	05.1	09.6	15°	6°

A thin but muscular supra-branchial valve or diaphragm is developed at the inner end of the excurrent siphon. When the siphonal structure is retracted (Fig. 2) this forms a "tube within a tube" structure; presumably it is a device for controlling the size of the excurrent aperture and the velocity of water ejection. A thin horizontal membrane connects the muscular branchial septum to the ventral surface of the posterior adductor and the posterior ends of the gill axes attach to this (Fig. 2).

An "acid" gland is situated in the mantle lobes where they fuse antero-ventrally.

(Figured by Pelseneer, 1911, pl. 7 fig. 7.) (See Jaccarini, Bannister & Micallef, 1968 for discussion of the function of this organ.)

The gills are of typical filibranch style with demibranchs of equal length and ascending and descending lamellae of both demibranchs are of equal height. Ciliary food grooves run along the ventral edge of each demibranch. Longitudinal rows of ciliary platelets loosely connect adjacent filaments and simple cross-bars connect the ascending and descending lamellae in the lower 2/3 of the gill.

Labial palps are of moderate length and strongly plicate. The inner and outer palps are approximately equal in length.

The ventricle is short, wide, quadrate and traversed its entire length by the rectum (for similar condition in *L. lima* see Fig. 12). The auricles are long and in-curved at the posterior end; they adhere closely to the lateral walls of the pericardium and are densely pigmented red-brown. Pericardial glands are not evident on the walls or floor of the pericardium. There is a major anterior artery leading forward dorsal to the rectum but no posterior artery was observed.

There is a dorsal cul-de-sac of the mantle cavity which passes over the posterior retractor and adductor muscles and forward to the posterior wall of the pericardium so that that thin membrane is all that separates pericardial fluids from the water in the mantle cavity. In the roof of the mantle cavity cul-de-sac the mantle lobes contain a rather hard, elongate mass which appears to have no ducts, apertures or internal cavities. Sections are needed to determine the cellular nature of this structure but it has the appearance of glandular tissue.

Left and right kidneys comprise a mass of pale-green tubules which is wide lateral and posterior to the pericardium, and extends some distance anteriorly. There is a wide reno-pericardial aperture in the ventral floor of each antero-lateral corner of the pericardium which opens directly into the lumen of the kidney. The renal apertures are very small and situated on small papillae in the roof of the supra-branchial chambers just lateral to the genital papillae (Fig. 4) and opening directly into the lumen of the kidneys.

When ripe the gonads fill the spaces between and above the posterior retractors, much of the visceral mass beside and below the pericardium, and the mesosoma. There is no gonad tissue in the mantle lobes.

Genital apertures are slits in prominent papillae in the roof of the supra-branchial chambers between the visceral mass and the gill axes immediately below the antero-lateral corners of the pericardium (Fig. 4).

A pair of major anterior genital ducts lay superficially on the visceral mass anterior to the pericardium leading backwards and then downwards to the genital apertures. A major pair of posterior genital ducts lies beneath the pericardium leading forwards to the apertures (see similar condition in *L. lima*, Fig. 12).

Plicate canals or "organs of Sabatier", consisting of thin-walled, transparent lamellae, cross between the visceral mass and the gill axes in the roof of the supra-branchial chambers (see Sabatier, 1877 and Field, 1922 for similar organs in *Mytilus edulis*). Plicate canals are present throughout the length of the supra-branchial chambers but are longest and most crowded posterior to the genital apertures (Fig. 4). There are no comparable structures between the mantle lobes and the gill axes.

Convoluting cords (or ducts?) are embedded in the translucent tissue of the gill axes, connecting the outer ends of the plicate canals with loops running inward along them to varying extent (Fig. 4).

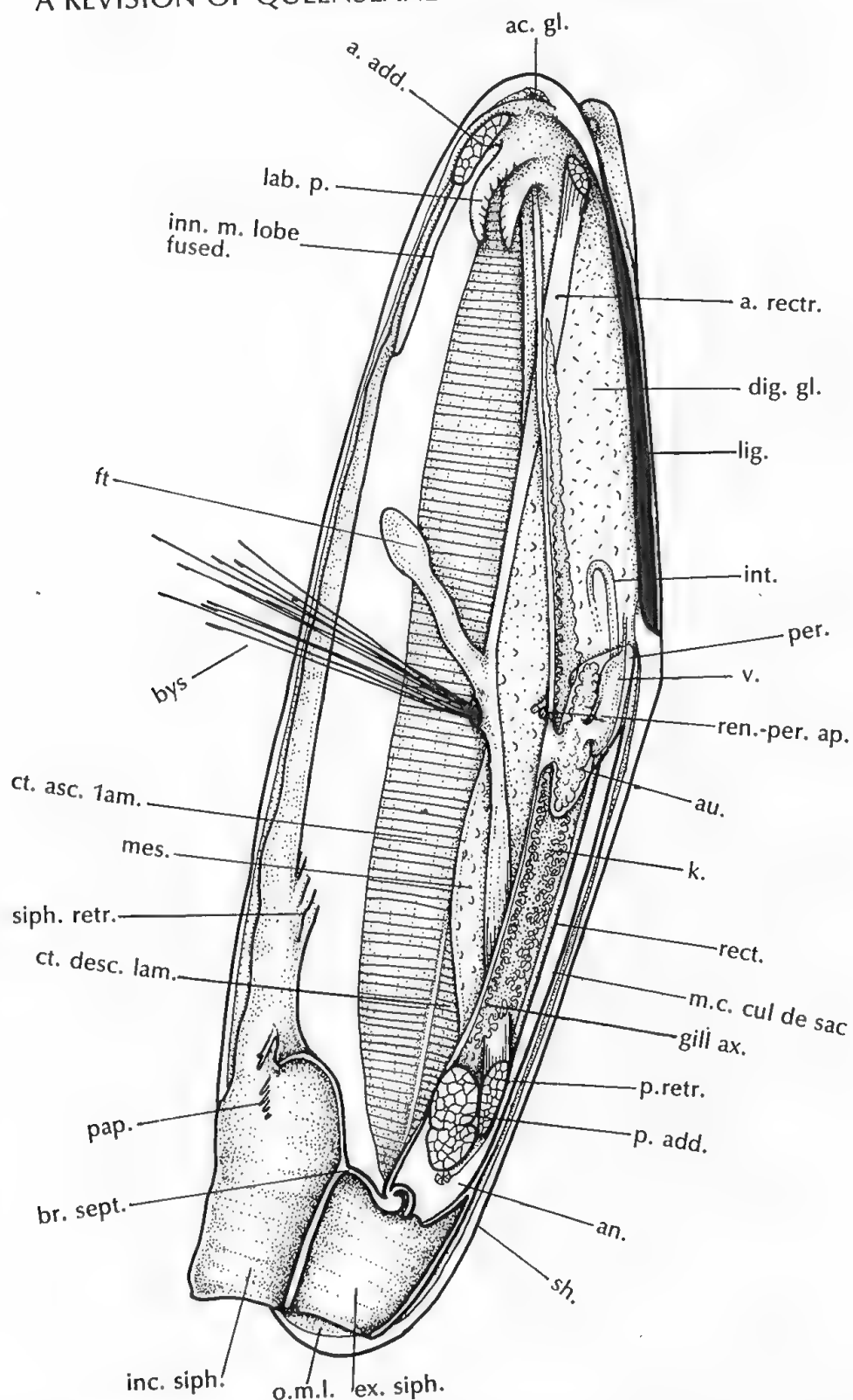


Fig. 2 *Lithophaga teres* (WAM 194-77). Semi-diagrammatic lateral view of soft parts. Siphons partly retracted. Ctenidium and mantle lobe of left side removed and posterior end presented as a sagittal section to illustrate details of structure of incurrent and excurrent siphons. Oesophagus, stomach and 1st arm of intestine not shown.

The oesophagus is short. Details of the stomach were not examined. The mid-gut lacks a separate style sac; in fact no style was present in any of the specimens examined which were all preserved in alcohol.

The first turn of the rectum is located immediately below the posterior end of the pericardium some distance in front of the posterior adductor. The second turn or recurrent loop of the rectum is located level with the rear end of the stomach and slightly off-set to the right side.

ANATOMICAL MATERIAL EXAMINED.

Queensland:

Rocky Point, Lizard I., WAM 193-77, from dead coral, 2-5m.

Watson Bay, Lizard I., WAM 195-77, from dead base of living *Favia* colony at 3m.

Lagoon bombies (coral outcrops) Lizard I., WAM 194-77, from dead centre of a large *Porites* "micro-atoll".

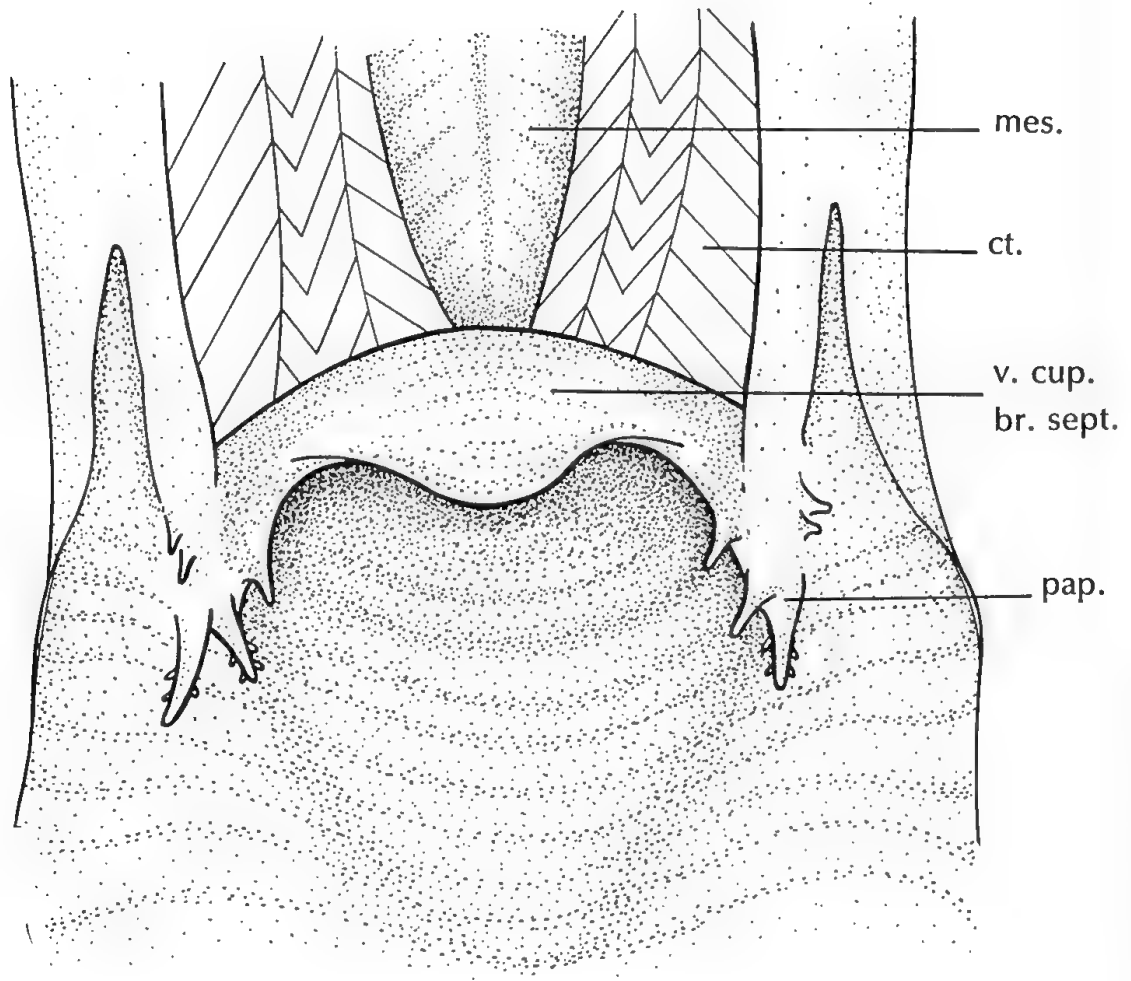


Fig. 3 *Lithophaga teres*. Incurrent siphon opened out and seen from below, illustrating the ventral cup of branchial septum and its papillae. 3a Low Isles, Qld (WAM 190-77).

Western Australia:

Kendrew I., Dampier Arch., WAM 13-76, underside of coral stones, intertidal reef flat.

Kwinana, Cockburn Sound, WAM 83-63, in dead coral at 3m.

Low Is., WAM 190-77, from dead coral, 3m and intertidal.

SE end Heron I. reef, WAM 191-77, from dead coral boulders on reef crest.

South side Heron I. reef, WAM 192-77, from dead coral at 4m.

Solomon Is:

Malaupaina I., WAM 187-77, in dead coral boulder on outer reef slope at 50m.

Caroline Is:

Kapingamarangi Atoll, WAM 202-77, in dead coral on lagoon bombie at 2m.

Malaysia:

Tg. Rhu, Palau Langkawi, WAM 36-73, in dead coral at low tide.

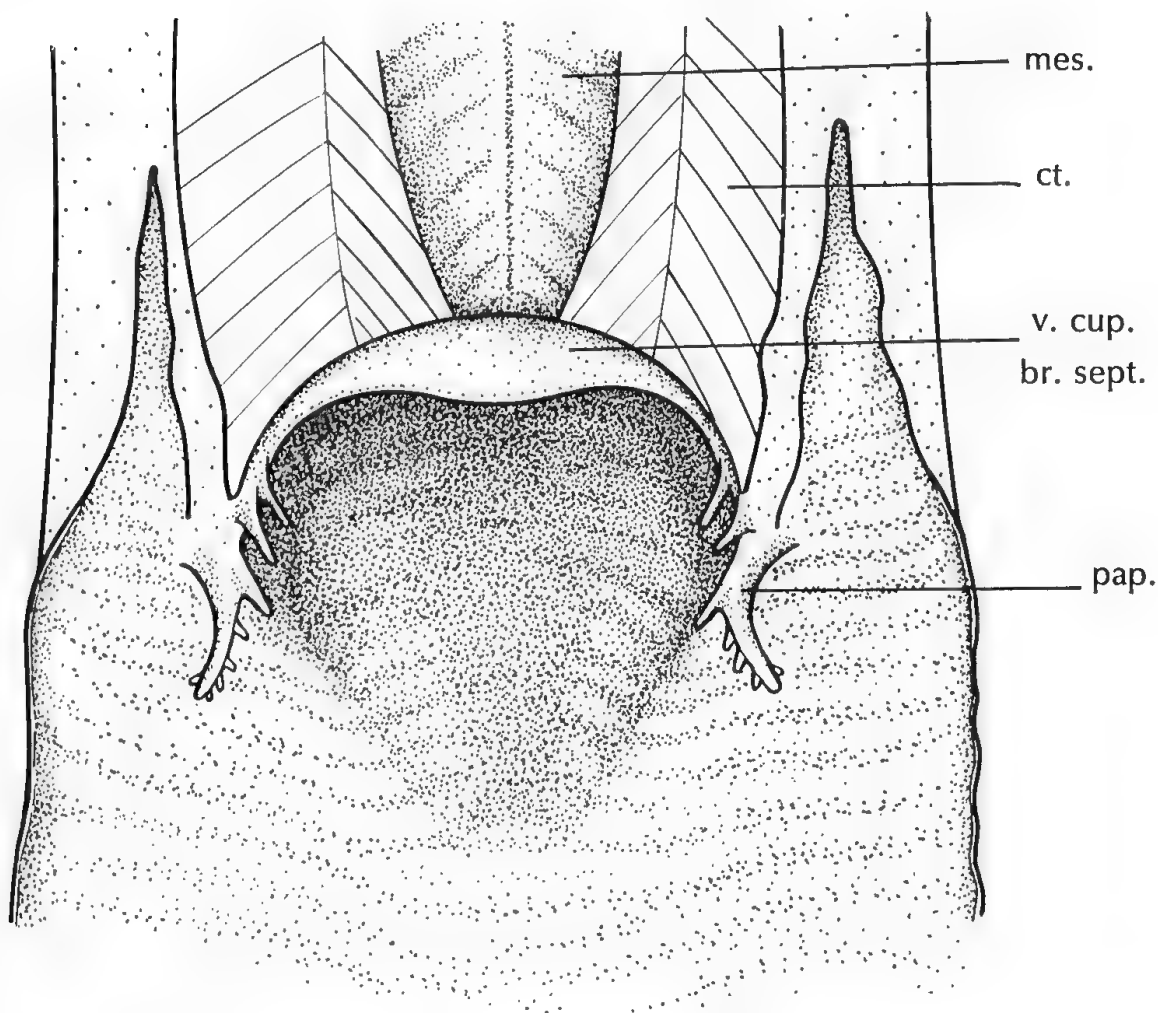


Fig. 3 *Lithophaga teres*. Incurrent siphon opened out and seen from below, illustrating the ventral cup of branchial septum and its papillae. 3b Heron I., Qld (WAM 192-77).

REMARKS: The variability in shell shape in this species is well recognized. Specimens from some localities are long and slender while others are short and stout. Iredale mentioned this and supposed that the species may be polytypic with many subspecies. A major morpho-metric study might demonstrate the existence of distinctive geographic variants but my impressions are that the variation is geographically inconsistent. An exception is to be found in W.A. populations which show an increasing stoutness coming down the coast into southern temperate waters. This trend appears to be clinal.

In view of such variation I cannot agree that sub-species should be recognized and relegate *L. teres annectans* Iredale to synonymy. The most elongate and slender specimens of all are perhaps those in the Red Sea for which Jousseume introduced the name *L. erythraensis*. In the absence of any other distinguishing character I have synonymized that name with *L. teres*. By the same token perhaps one should synonymize *L. teres* and the tropical Atlantic species *L. nigra* (d'Orbigny, 1842) for that species also is

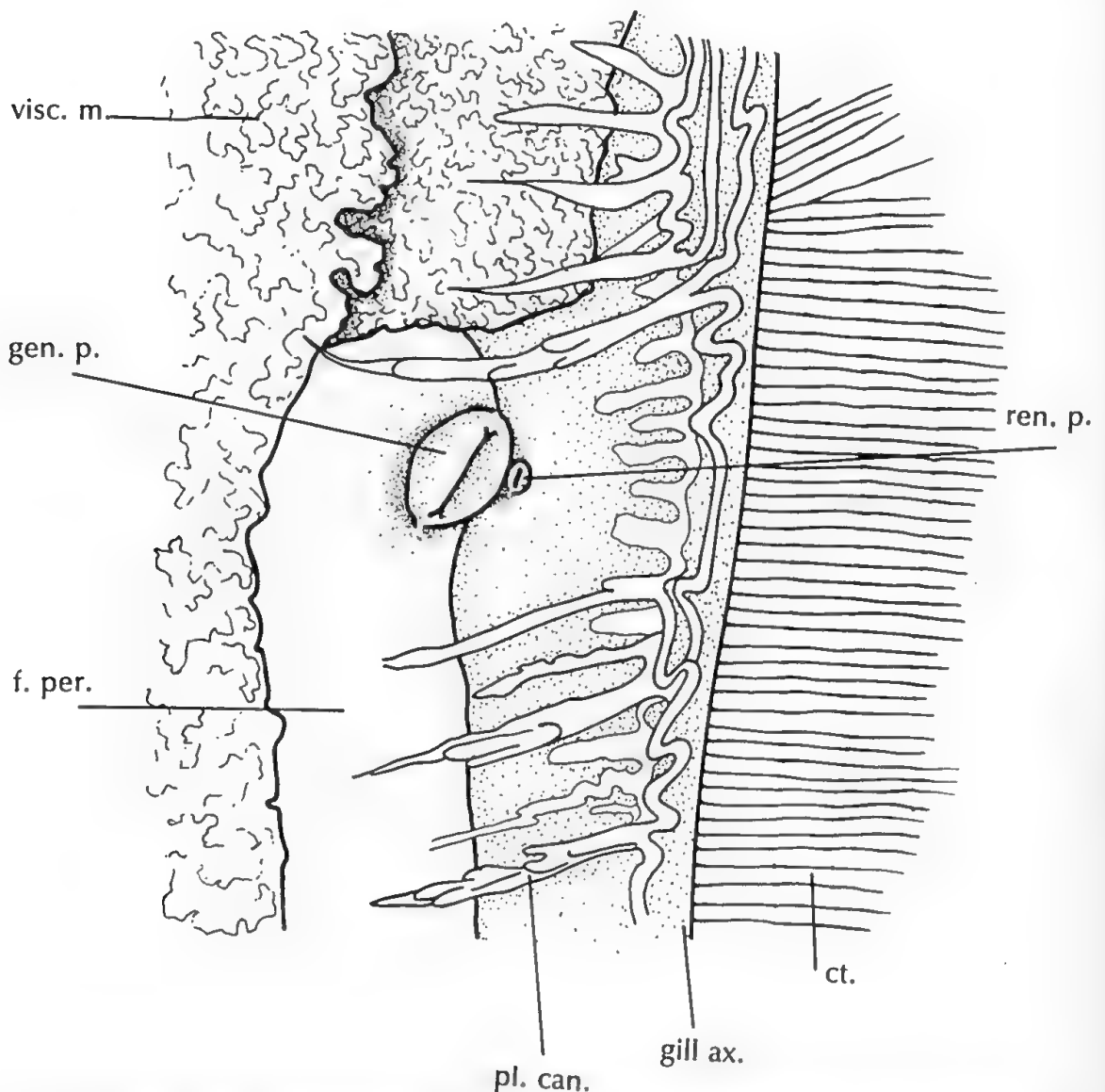


Fig. 4 *Lithophaga teres* (WAM 190-77). Roof of mantle cavity of the right side seen from below illustrating the plicate canals and the location of the renal and genital apertures.

apparently indistinguishable on shell characters (see Turner & Boss, 1962: 98), but I am not brave enough to take that drastic step without a comprehensive morpho-metric study.

Several anatomical characteristics of *L. teres* bear note.

The ctenidia are quite like those of *Mytilus* in that the inter-lamellar connections are simple tissue bars. "Plicate canals" in the supra-branchial chambers between the visceral mass and the gill axis resemble the structures described by Sabatier (1877) and Field (1922) in *Mytilus edulis*, although in that mussel the lamellae are present on both sides of the gill axes. Field (1922: 166) described the plicate canals of *Mytilus edulis* as "composed of two thin membranes of fibrillar tissue united to each other by strands of the same kind of tissue, which form a regular spongy reticulum in the cavity. The space between them is a blood channel which connects the veins of the mantle with the blood vessels of the kidney and with the longitudinal vein". Field (1922: 168) claimed that the plicate canals have a supplementary respiratory function, especially when the mantle lobes are distended with gonad tissue. At that time the plicate canals "become enlarged and well filled with blood which flows through them from the mantle to the kidney and longitudinal vein". He proposed that they might well be termed "the accessory gills". It is here supposed that the lamellae between the visceral mass and the gill axes in *L. teres* may be homologous and have a similar function, although the nature and function of the convoluted tubes they contain is problematical.

Pericardial glands in *L. teres* are probably represented by the heavy pigmentation of the auricle walls. In *Mytilus edulis* pericardial glands "invest the outer walls of the auricles" (Field, 1922: 168).

Unlike *Mytilus edulis* the mantle lobes of *L. teres* are thin and not invaded by gonad tubules. Gonad tissue is confined to the visceral mass.

Although I have not been able to examine in detail well preserved specimens of *Lithophaga lithophaga*, descriptions and illustration by List (1902), and cursory examination of indifferently preserved specimens in the WAM collections, indicate that this species shares these anatomical characteristic with *L. teres*.

Lithophaga antillarum (d'Orbigny, 1842)

(Fig. 16 (4))

Lithodomus antillarum d'Orbigny (in) Sagra, 1842: pl. 28, figs. 12-13. Type locality: Guantánamo, Oriente, Cuba (restricted thus by Turner & Boss 1962: 101). Type: B M (NH) regn. no. 54.10.4.605.

Modiola corrugata Philippi, 1846: 147, pl. 1, fig. 1. Type locality unknown. Type not located.

DISTRIBUTION: This species is uncommon but apparently widely distributed in the Indo-West Pacific Region and in the tropical Western Atlantic. Museum and literature records are as follows:

Western Atlantic: "from Miami, Florida south through the West Indies and in Central America from Veracruz, Mexico south to British Honduras" (Turner and Boss, 1962).

Indo-West Pacific: Mauritius (AM regn. no. C74661, identity uncertain); Madras, India (Ummerkuty, 1960); Gulf of Siam (Lyng, 1909); southern Japan (Okada, 1960); New Caledonia (Lamy, 1937; AM regn. no. C3929); Fiji (AM regn. no C56414).

Queensland: Mast Head I. (Hedley, 1906), Low Isles (AM regn. no. C89643), Fairfax I, Bunker Group (AM regn. no. C69053), Heron I. (WAM 30-73).

Dr K. Kleeman (pers. comm.) has informed me that the records from Madras, Gulf of Siam and southern Japan "are probably not representing *L. antillarum*".

HABITAT: Data on habitat are inadequate. Turner and Boss (1962) state that *L. antillarum* burrows in both living and dead coral in the Western Atlantic. At Heron I. I found one juvenile specimen burrowing in a coral boulder in the boulder tract of the outer reef flat.

DESCRIPTION: SHELL: Moderately thin; elongate-elliptical, rather attenuate anteriorly. Sculptured antero-ventrally by fine, crowded cords which are more-or-less parallel and vertical near the anterior end but become curved centrally; posteriorly and postero-dorsally the cords are irregularly radiating or chevron-shaped. Interior shiny white, sometimes slightly iridescent; exterior uniformly white covered by a thin, smooth pale yellow or yellow-brown periostracum. Umbos sub-terminal; anterior end narrowly rounded, posterior end broadly rounded; dorsal margin (hinge-line) rather short and slightly convex; ventral margin slightly convex; postero-dorsal margin straight or slightly convex; dorsal angle low and poorly defined.

There are no superficial calcareous incrustations but the posterior ends of the valves may be thickened and lip-like as in *L. teres*.

Turner & Boss (1962) give 10.9cm as the maximum recorded length for Western Atlantic specimens. The largest specimen recorded from Indo-West Pacific localities is 14.5cm long (Heron I., Qld, pers. comm. K. Kleeman). Dimensions of the available Qld material are given in Table 3.

ANATOMY: The only preserved specimen available to me is an indifferently preserved juvenile from Heron I. which is adequate to determine only the following facts.

The musculature is essentially the same as in *L. teres* except that there are several thin strands arising from the pedal-byssal complex anterior to the origin of the posterior retractors.

Descending ventrally from the anterior edge of the branchial septum is a fairly thick, cup-shaped partition like that of *L. teres*. Its margin is smooth but there are 2 small papillae at each lateral corner, and another actually on the adjacent mantle lobe of each side.

The gills in this juvenile specimen are unlike those of *L. teres* in that there are no inter-lamellar bars. Instead there are entire septa in the lower parts of the demibranchs, spaced at intervals of about 5-8 filaments and rising to about 1/5 of the gill height.

The heart is like that of *L. teres* with thickly pigmented auricles. A dorsal cul-de-sac of the mantle cavity passes over the posterior retractor and adductor muscles and reaches the posterior wall of the pericardium as in *L. teres*. There is also a hard, amorphous mass in the mantle lobes above the dorsal cul-de-sac like that described in *L. teres*.

The kidneys are thin-walled and colourless and it was not possible to determine their extent along the gill axes or the details of their connections to the pericardium. The renal apertures are small thin slits in the inner sides of the gill axes as in *L. teres*.

Though the specimen is juvenile there are white (male?) gonad follicles in the visceral mass anterior to and below the pericardium but there are none in the mantle lobes which are very thin and transparent. A mesosoma is not developed. The genital apertures are slits on papillae adjacent to the renal apertures as in *L. teres*.

Structures resembling small plicate canals are present between the gill axes and the mantle lobes but on the inner sides between the gill axes and the visceral mass there are

Table 3

Dimensions of *L. antillarum* (in mm).

<i>Atlantic</i> (Turner & Boss, 1962)	length	height	width	lig length	A°	B°
Florida, U.S.A.	109.5	25.0	—	—	—	—
Florida, U.S.A.	101.0	26.5	—	—	—	—
Florida, U.S.A.	83.5	23.5	—	—	—	—
Santo Domingo	44.0	12.5	—	—	—	—
<i>Pacific</i>						
Fiji (AM C56414)	89.4	26.7	20.4	—	—	—
New Caledonia (AM C3929)	89.0	22.9	17.6	—	—	—
Fairfax I., Qld (AM C69053)	100.3	26.0	20.6	—	—	—
Low Is, Qld (AM C89643)	27.5	07.6	06.4	—	—	—
Heron I, Qld (WAM 30-73)	47.4	12.3	09.5	19.2	16°	11°

only a few low ridges with small depressions between them, anterior to the renal and genital apertures.

REMARKS: The shell of *L. antillarum* most closely resembles that of *L. teres* being sculptured and lacking any secondary calcareous incrustations but is easily distinguished by the presence of radiating or chevron-like sculpture on the postero-dorsal surface. It is also rather more slender than *L. teres* and the periostracum is usually yellow-brown and not chocolate brown to black as it is in that species.

Anatomically *L. antillarum* also resembles *L. teres*. It appears that gonad follicles do not invest the mantle lobes though mature specimens are needed to confirm this. The structure of the branchial septum is like that of *L. teres* with small lateral papillae on the lateral corners of the ventral cup-shaped partition and on the adjacent mantle lobes. Another structure peculiar to these two species is the hard, amorphous mass in the dorsal mantle lobes behind the pericardium and lining the roof of the dorsal cul-de-sac of the mantle cavity. The function of this structure is unknown.

Genital and renal apertures are situated like those of *L. teres* and not in a deep supra-branchial pocket like those of the other Qld lithophagines. But anterior to them there are neither plicate canals nor a series of supra-branchial pockets. This may also be because of the immature nature of the specimen.

Perhaps the most remarkable thing about *L. antillarum* is its distribution. Turner & Boss (1962) have shown the lack of morphological characters distinguishing Western Atlantic and Indo-West Pacific shells and there is no option but to regard these widely separated populations as belonging to the same species.

Lithophaga lessepsiana (Vaillant, 1865)

(Fig. 18 (6-10); text figs. 5-8)

Lithodomus lessepsiana Vaillant, 1865: 115 and 123; figured Savigny, 1817: pl. 11, fig. 1. Type locality: Suez. Syntypes: MNHN (Paris), 2 broken specimens.

Lithophaga simplex Iredale, 1939: 421, pl. 6, fig. 25. Type locality: Low Isles, Qld. Holotype: AM regn. no. C60403.

DISTRIBUTION: Arnaud & Thomassin (1976; table 3) list the following localities for *L. lessepsiana* burrowing in the solitary coral *Heteropsammia michelini*: Red Sea, Madagascar, Zanzibar, Seychelle Is., Maldive Is., Eniwetok Atoll, Chinese Sea, Lizard I. and Port Curtis, Qld.

From AM and WAM collections I can add the following localities for *L. lessepsiana* burrowing in various colonial corals: Malaupaina I. (Solomons), Darwin (Northern Territory), Kendrew and Rosemary Is., Dampier Archipelago (W.A.), Lizard I., Low Isles, Michaelmas Cay, Heron I., North West I., Moreton Bay (QLD).

Thus it is apparent that *L. lessepsiana* is widely distributed in the tropical Indo-West Pacific Region.

HABITAT: This is one of the few lithophagids which habitually burrows in living corals. The entrance of the burrow is always located among living polyps and never in dead parts of the corallum.

Iredale (1939) reported that this species "is only found in living *Porites* and *Symphyllia*", but it is in fact commonly found burrowing in several kinds of branching corals. I have found it abundantly in *Acropora palifera* and *Pocillopora eydouxi* at Heron I. (Qld.), Dampier Archipelago (W.A.) and the Solomon Is. (but not in the more common species *Pocillopora damicornis* living adjacent). Vaillant (1865) and Fishelson (1973) report it from the Red Sea in *Stylophora pistillata*. Soliman & Gohar (1963a) report it from the red Sea in *Sytlophora? flabellata*. At Heron I. I found it boring in prostrate forms of *Acropora palifera* growing in exposed positions on the reef flat but I have not seen it in the branching ("staghorn") species of *Acropora*. At Lizard I., Low Isles, Dampier Archipelago and the Solomon Is. *L. lessepsiana* is also common, boring in massive corals of the genera *Porites* and *Favia* but I have not been able to determine which species.

Arnaud and Thomassin (1976) describe the geographical and ecological distribution and the burrows of *L. lessepsiana* in the free living scleractinian coral *Heteropsammia michelini* living on soft substrates in lagoon or reef-slope situations. Significantly they did not find the lithophagine in other solitary corals (e.g. *Heterocyathus aequicostatus* and *H. rousseauanus*) living in the same or similar biotopes.

DESCRIPTION: SHELL: Smooth, very thin and fragile. Iridescent internally, with a shiny yellow-green periostracum. Moderately elongate and cylindrical; umbos terminal or sub-terminal; anterior end deep and rounded, posterior end broadly rounded. Ventral margin only slightly convex; hinge-line and postero-dorsal margin almost straight; dorsal angle relatively low. Calcareous incrustations over the periostracum thin and poorly developed. Antero-dorsally there is a loose pasty covering of calcareous particles and mucous.

Ventrally and posteriorly there is a very thin discontinuous crusty, calcareous layer which may be smooth or cast into divaricating threads or a reticulate pattern of intersecting

concentric and radial threads. There may be thick, dentate terminal accretions posteriorly extending beyond the end of the valves.

The nature of the superficial calcareous incrustations was observed to vary according to the identity of the host coral at Lizard I. Shells from *Favia* are generally smooth and terminal thickenings are small or lacking (Fig. 18(8)). Shells from *Acropora* and *Pocillopora* usually have a weak reticulate pattern on the postero-dorsal area and small terminal thickenings (Fig. 18(10)). Shells from *Porites* are more strongly encrusted with a reticulate or divaricate pattern and the terminal thickenings are relatively heavy, projecting, and dentate on their inner surfaces (Fig. 18(9)). Specimens burrowing in *Favia* sgem also to reach a greater size than those burrowing in other corals.

DIMENSIONS: The syntypes of *L. lessepsiana* and the holotype of *L. simplex* are all broken and a full set of measurements of these specimens is not possible. Data for series from Low Isles and Lizard I. populations are given in Table 4.

ANATOMY: Though similar in basic arrangement the structural detail of the branchial septum in *L. lessepsiana* differs from that of *L. teres* (compare Figs. 2 and 5). The antero-ventral extension is much shorter and the diaphragm-like membrane across the inner end of the excurrent siphon is a simple, thin structure with a narrow horizontal slit across the centre.

The ventral partition of the branchial septum is strongly papillate along its margin (Figs. 5 and 6). There is a large, compressed and digitate central lappet with 3-9 branches. It is flanked on each side by 1-3 small simple papillae and a lateral papilla in the corners by the mantle lobes bearing 2-3 branches.

The outer surface of the incurrent siphon is cream or fawn with a wide brown band a short distance forward from the posterior margin; bands of left and right sides meet dorsally and encircle the excurrent aperture. Internally the incurrent siphon is fawn near the posterior margin but elsewhere brown flecked with white except for two fawn lines which begin at the corners of the branchial siphon and converge dorsally at immediately below the margin of the excurrent aperture.

The first loop of the rectum lays on the dorsal surface of the posterior adductor.

Table 4

Dimensions of *L. lessepsiana* (in mm)

Topotypic series *L. simplex*,

Low Is, Qld.	length	height	width	lig length	A°	B°
WAM 178-77	30.1	10.2	07.8	11.6	23°	16°
WAM 178-77	27.0	10.5	11.2	08.9	28°	17°
WAM 178-77	29.1	09.9	08.6	11.0	25°	18°
WAM 35-73	27.0	08.8	07.4	12.9	22°	15°
WAM 35-73	22.1	08.5	06.4	08.8	30°	18°
WAM 35-73	30.1	08.1	06.0	10.2	15°	13°
WAM 35-73	15.3	05.9	04.8	06.0	27°	15°

The auricles are thin, transparent and lack pigmentation. Otherwise the heart is like that of *L. teres* and *L. lima* (see Fig. 10).

An "acid" gland was not located.

Instead of plicate canals in the supra-branchial chamber between the visceral mass and the gill axis there is a single axial series of 6 or 7 deep rounded pockets in the roof of the supra-branchial chamber anterior to the pericardium (Fig. 7). The pockets are separated from each other by broad transverse bars of transparent tissue which may be homologous with the plicate canals of *L. teres*.

The largest of these supra-branchial pockets are the most posterior pair, located directly below the antero-lateral corners of the pericardium. They possess anterior extensions or diverticulae which form small compressed chambers deep within the body of the visceral mass, lined by a thin epithelium. These diverticulae appear to have no ducts or apertures to the exterior, pericardium or any other organ except for the wide gape opening into the large supra-branchial pockets.

Kidney tissue is visible in the rooves of the supra-branchial pockets along their gill axis (lateral) sides; the inner sides of the pockets are walled by gonad (the large posterior pocket) or digestive gland (the anterior pockets).

Posterior to the supra-branchial chamber there are no such pockets. In the roof of the chamber in that region the ventral wall of the kidney is visible along the outer (lateral) side and the ventral pericardial wall is visible along the inner side. Only the thin, nearly transparent wall of the pericardium separates pericardial fluids from water in the supra-branchial chamber.

Between the gill axis and the mantle lobe there are short transverse, transparent strands apparently equivalent to the plicate glands of other mytilids.

Genital and renal apertures are located on papillae on the lateral wall of the large posterior supra-branchial pocket immediately below the antero-lateral corners of the pericardium. The genital papillae are prominent; the renal papillae are smaller but easily visible under moderate magnification adjacent and lateral to the genital papillae (Fig. 7).

Gonad tubules, when in ripe condition, spread superficially over the dorsal surface of the digestive gland anterior to the pericardium, fill the small mesosoma and the space between the diverging posterior retractors, and also fill the mantle lobes which are consequently thick and opaque. Ovary is purplish brown; testis is white.

Anterior and posterior genital ducts are present in the visceral mass as in *L. teres* but there is also a dendritic system of ducts ramifying through the mantle lobes, connecting to the primary anterior visceral ducts just in front of the genital papillae.

The kidneys comprise massed, green, thin-walled tubules lying above and along the whole length of the gill axis. The kidney mass is wide and strongly diverticulate posteriorly, narrow and less diverticulate in front of the pericardium. The renopericardial apertures are broad ventral slits in the antero-lateral corners of the pericardium opening directly into the kidney lumen (Fig. 5).

Inner and outer lamellae of the ctenidial demibranchs are held together by inter-lamellar membranes instead of inter-lamellar bars as in *L. teres*. The membranes occur every few filaments along the demibranchs; they are entire and rise to a height equal to about $\frac{1}{3}$ of the height of the outer lamellae. Labial palps are approximately equal in size (Fig. 8).

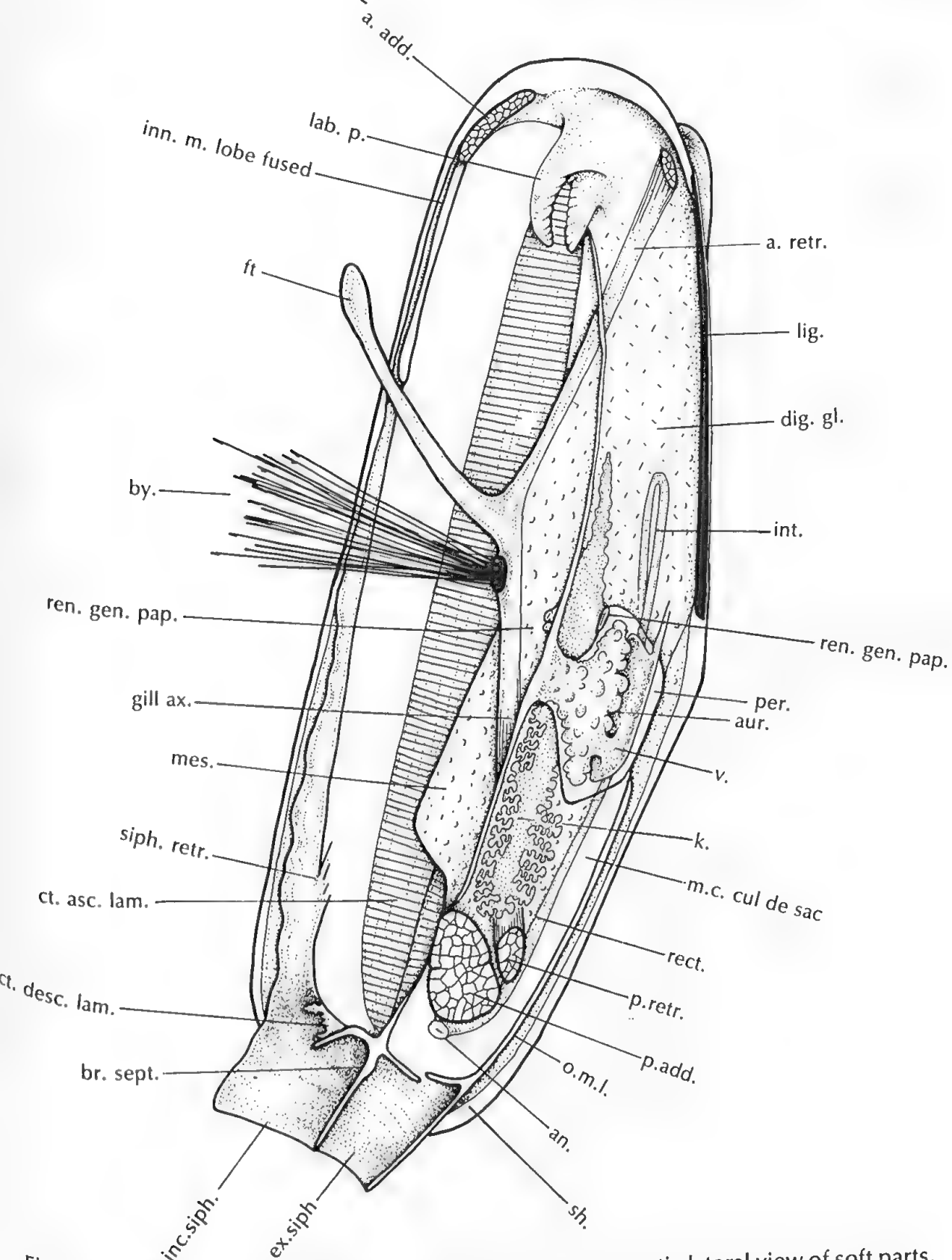


Fig. 5 *Lithophaga lessepsiana* (WAM 153-77). Semi-diagrammatic lateral view of soft parts. Siphons extended. Ctenidium and mantle lobe of left side removed and posterior end presented as a sagittal section to illustrate details of structure of the incurrent and excurrent siphons. Oesophagus, stomach and 1st arm of intestine not shown.

ANATOMICAL MATERIAL EXAMINED.

Queensland:

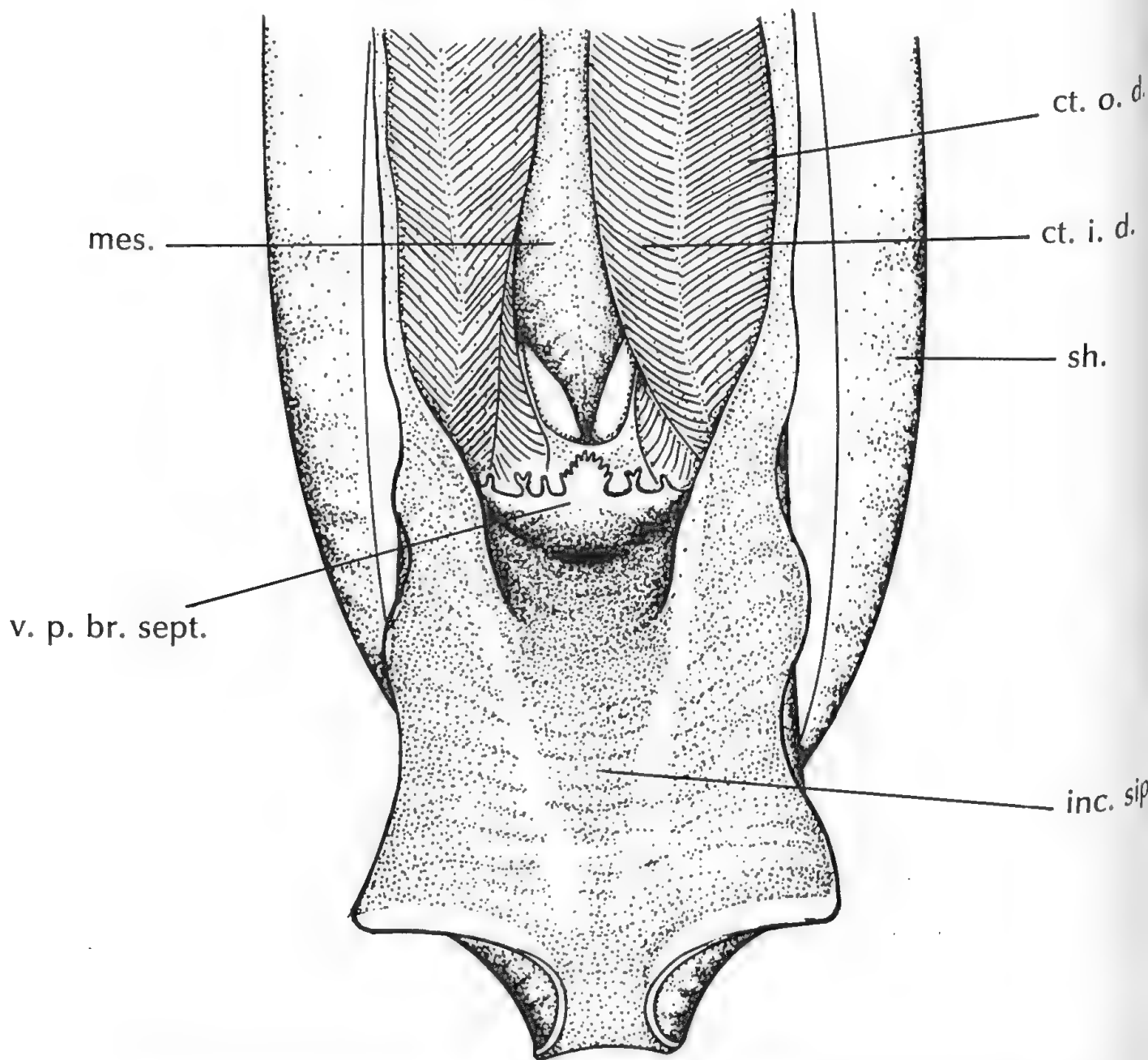
Rocky Point, Lizard I., WAM 179-77, 154-77, 153-77, in *Porites*.Watson Bay, Lizard I., WAM 173-77, 177-77, in *Favia*.Lagoon, Lizard I., WAM 158-77, in *Pocillopora*.Casuarina Beach at low tide, Lizard I., WAM 176-77, in *Favia*.Low Isles, WAM 161-77, 35-77, in *Porites*.

Fig. 6 *Lithophaga lessepsiana* (WAM 33-73). Incurrent siphon opened out and seen from below, illustrating the ventral partition of the branchial septum and its papillae.

Low Isles, WAM 178-77, in *Favia*.

Michaelmas Cay, WAM 175-77, in *Favia*.

Lagoon, Heron I., WAM 33-73, in *Pocillopora eydouxi*;

Reef flat at low tide, Heron I., WAM 172-77, 171-77, in *Acropora* sp;

Lagoon, Heron I., WAM 164-77, 165-77, in *Acropora palifera*.

Western Australia:

Kendrew I., Dampier Archipelago, WAM 174-77, 167-77, in *Pocillopora eydouxi*;

Solomon Is:

Malaupaina I., WAM 166-77, in *Pocillopora eydouxi*.

REMARKS: Having compared the types of *L. lessepsiana* and *L. simplex* I am satisfied that they belong to the one species in spite of the geographic distance between the type localities.

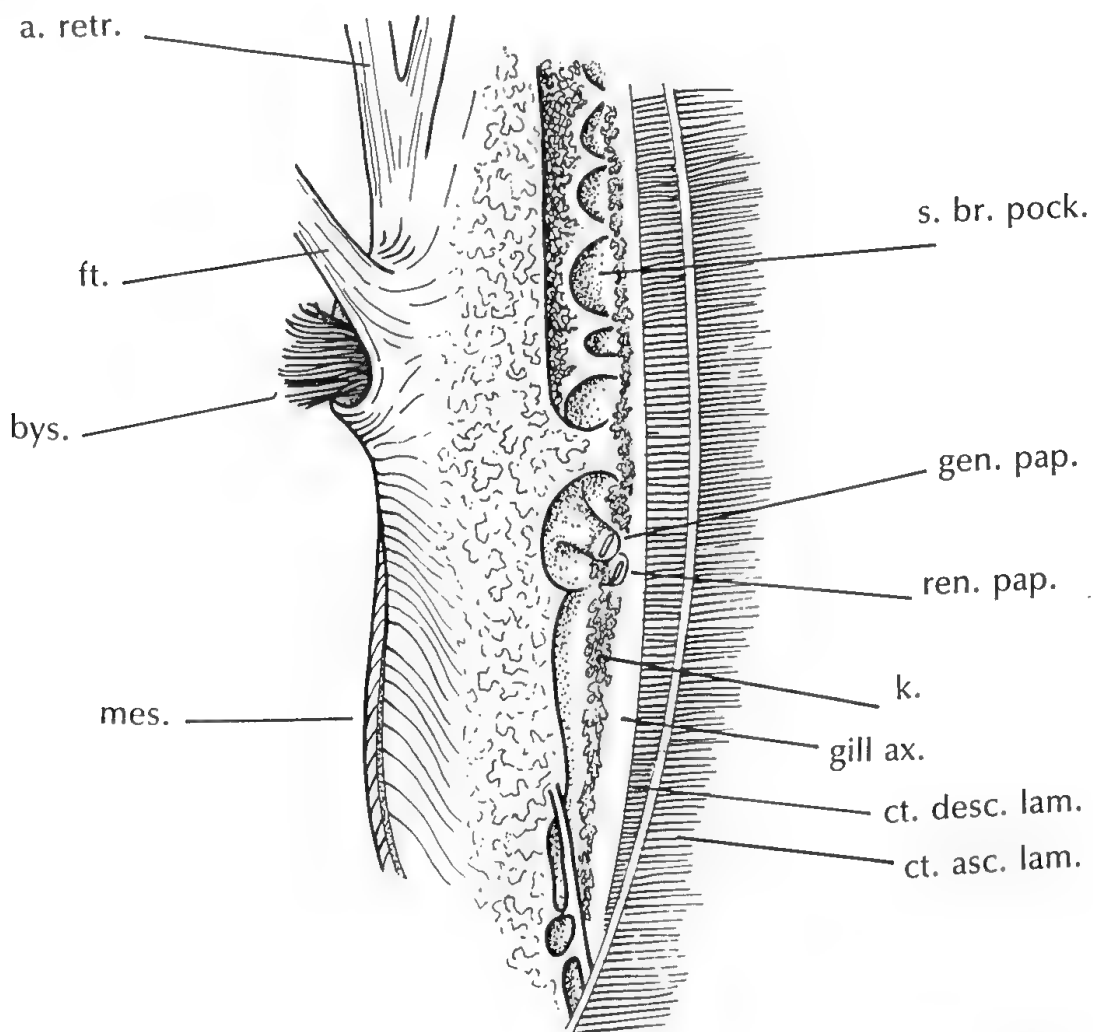


Fig. 7 *Lithophaga lessepsiana* (WAM 153-77). Roof of mantle cavity of the right side illustrating the series of supra-branchial pockets and the location of the renal and genital apertures.

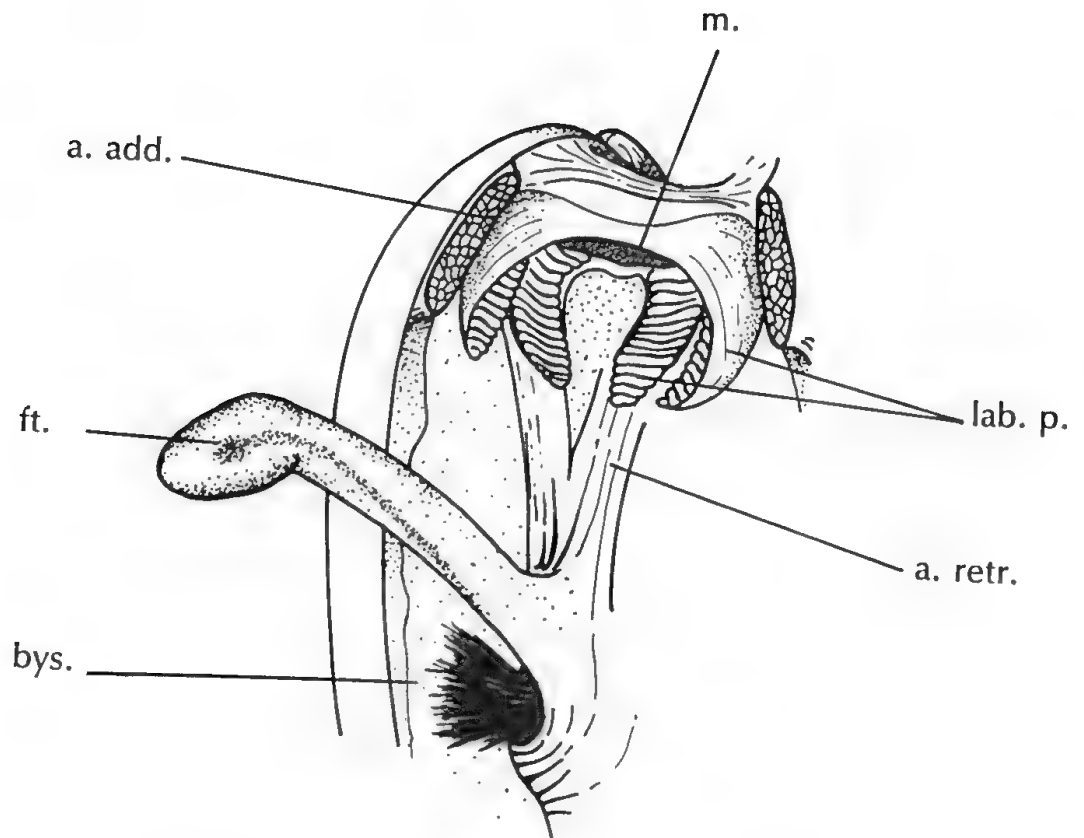


Fig. 8 *Lithophaga lessepsiana* (WAM 153-77). Diagram illustrating the mouth and labial palps as seen from below. Ctenidia excluded.

Gohar & Soliman (1963a) described the anatomy, shell and burrow of this species in the Red Sea under the name *L. cumingiana* Dunker. This name is actually attributable to Reeve (1857) who indicated that it was a Dunker manuscript name. I have examined Reeve's type and agree with Olsson (1961) that it belongs to the American species *L. peruviana* d'Orbigny (1846). The confusion was compounded when Dunker (1882) used the name himself but giving the type locality as New Holland. I have been unable to locate any specimens which could be regarded as the types of *cumingiana* Dunker (1882) other than those described by Reeve, and consider that this name should henceforth be regarded as a junior objective synonym of *cumingiana* 'Dunker' Reeve (1857).

The description of *L. lessepsiana* and its habitat given by Gohar & Soliman (1963a) leaves no doubt about the conspecificity of their material from the Red Sea with mine from Australian and Solomon Is. localities.

Some of the anatomical features differentiating *L. lessepsiana* from *L. teres* appear to have major significance, viz: the lack of pigmentation on the auricle walls, the absence of plicate canals between the visceral mass and the gill axis, and the presence of supra-branchial pockets, the presence of gonad tissue in the mantle lobes, and the presence of inter-lamellar membranes instead of bars in the ctenidia.

Of special interest are the supra-branchial pockets and the deep visceral diverticulae of the most posterior pair, and the exposure of the pericardial wall in the roof of the supra-branchial chamber. No explanation of these structures can be offered except that it is likely they may be involved with respiration and ionic balance and thus have similar function to that assumed for the plicate canals of *L. teres* and *Mytilus edulis*.

The differences in the nature of the superficial incrustations between shells taken from different host coral genera are noteworthy. I could find no evidence of corresponding anatomical differences and conclude that a single species is involved and that the form taken by the incrustations is influenced by the form or biology of the host.

***Lithophaga nasuta* (Philippi, 1846)**

(Fig. 17 (2); text fig. 9)

1846 (Oct.) *Modiola nasuta* Philippi, *Abbildungen und Beschreibungen neuer oder wenig gekannter Conchylien*, 3: 149, pl. 1, fig. 2 (Pacific Ocean). Type: MNHN, Santiago, Chile (pers. comm. K. Kleeman).

1939 *Lithophaga dichroa* Iredale, *Scient. Rep. Gt. Barrier Reef Exped.*, 5 (6): 421, pl. 6, fig. 31. (Low Isles, Qld). Holotype: AM regn. no. C60404.

DISTRIBUTION: The whole range is uncertain but *L. nasuta* is common at least throughout the south-western Pacific, northern Australia and the Indo-Malay Archipelago. Prashad (1932) records it from Sulawesi, Ambon and Sulu Archipelago. Adam & Leloup (1939) record it from Misool. I have collected it in the Solomon Islands, north-western Malaysia, Fiji, and Dampier Archipelago in northern W.A. In the WAM and AM there are specimens from the following Qld. localities: Lizard I., Low Is., Lindeman I., Heron I., Moreton Bay.

HABITAT: *L. nasuta* is principally an intertidal species (though occasionally found in the shallow sublittoral) and bores in any calcareous rocks. It is often abundant in sloping calcareous beachrock platforms high in the intertidal zone and must play an important role in the break up of these sediments. Its burrows are a conspicuous feature of the beachrocks at Heron, Lizard and Low Is and have been described in detail by Otter (1937) under the name *L. cumingiana* (see remarks for *L. lessepsiana* for comments on this name). In this situation it is usually accompanied by the mussel *Botulopa silicula* (Lamarck) (= *Modiolus cinnamomeus* of Otter).

DESCRIPTION: SHELL: Smooth, moderately thin. Interior iridescent, often bluish. Exterior uniformly pale brown, periostracum light brown antero-ventrally and below the hinge, dark purple — brown in a broad radial umbonal ray. Cylindrical; umbos terminal; anterior end curved but sloping making the shell appear to be leaning forward, posterior end broad and bluntly rounded. Ventral margin slightly convex; dorsal margin (hinge-line) straight; postero-dorsal margin straight; dorsal angle low.

Below the umbonal ray there is a continuous smooth and hard chalky layer; over and above the umbonal ray there is little if any superficial incrustation; posteriorly there are thick but smooth deposits which project only a little beyond the ends of the valves.

Dimensions of a topotypic series of *L. dichroa* are given in Table 5.

Table 5

	Dimensions of <i>L. nasuta</i> (in mm)					
	length	height	width	lig length	A°	B°
Holotype <i>L. dichroa</i> (AM C60404)	57.7	17.7	14.2	24.4	19°	11°
Topotypic series <i>L. dichroa</i> Low Is (WAM 86-77)	57.9	19.2	14.2	22.6	20°	17°
	62.6	18.0	14.1	26.4	19°	14°
	51.0	17.8	13.9	20.8	22°	10°
	51.1	16.4	12.1	23.4	17°	10°
	50.1	16.2	12.3	20.3	18°	11°
	50.1	16.5	13.4	21.4	23°	14°
	47.5	16.0	11.8	20.0	22°	12°
	40.5	13.6	10.3	14.0	21°	10°
	39.7	14.2	11.1	18.8	25°	15°

ANATOMY: The ventral partition of the branchial septum has prominent branching papillae along its edge (Fig. 9). There is a large, compressed, multi-digitate one at the centre, a smaller multi-digitate papillum in each corner, and one or more small digits in between which may be simple or have two branches.

Inner and outer surfaces of the siphons and the branchial septum are brown flecked with white patches except as follows. At the posterior edges there is a pale brown or buff band. On the upper inner wall of the incurrent siphon there is a pair of conspicuous white pathways which arise laterally where the partition of the branchial septum joins the mantle wall, and pass upwards and backwards close to the medial line to a position at the posterior edge of the siphon below the excurrent aperture. Application of indian ink to living specimens showed these pathways to be strongly ciliated rejection tracts along which unwanted particles are carried from the mantle cavity to an ejection point at the base of the excurrent siphon.

Digestive gland is dull olive-green.

The first loop of the rectum turns just before reaching the posterior adductor.

Auricles are thick and pigmented (orange).

Plicate canals are lacking between the visceral mass and the gill axes but axial series of deep supra-branchial pockets are present there. The largest pair of these is located below the antero-lateral corners of the pericardium and possesses a deep anterior-dorsal extension into the visceral mass. Supra-branchial pockets occur both anterior and posterior to this large central (cf. *L. lima*) one although the posterior pockets are quite small.

Genital and renal apertures are located on small papillae in the large central supra-branchial pockets as in *L. lessepsiana*.

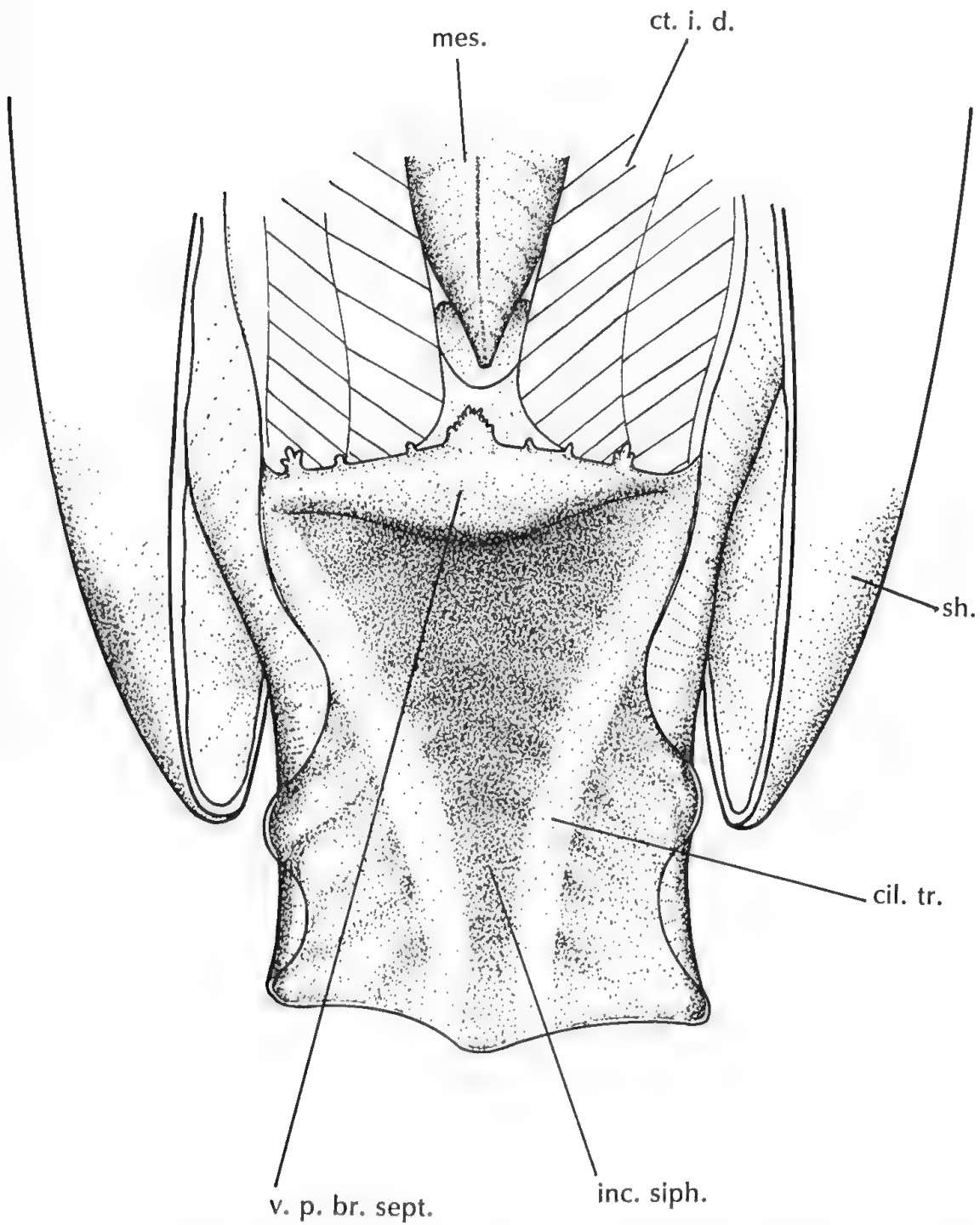


Fig. 9 *Lithophaga nasuta* (WAM 86-77). Incurrent siphon opened out and seen from below, illustrating the ventral partition of the branchial septum and its papillae and the ciliated rejection tracts in the roof of the incurrent siphon.

Gonads fill the mantle lobes and a small mesosoma, and spread superficially over the visceral mass as in *L. lessepsiana*. Testis is cream; ovary is purplish brown.

Ctenidia and kidneys as in *L. lessepsiana*.

ANATOMICAL MATERIAL EXAMINED.

Queensland:

Watson Bay, Lizard I., WAM 78-77, in dead parts of *Favia*, 3 metres.

Casuarina Beach, Lizard I., WAM 84-77, in oyster mass growing on granite, high intertidal zone.

Low Is., WAM 85-77, 86-77, in beach-rock.

Low Is., WAM 459-76, in dead *Porites*, intertidal.

Heron I., WAM 88-77, in beach-rock.

Western Australia:

Kendrew I., Dampier Archipelago, WAM 81-77, in beach-rock, and WAM 207-77, in dead coral boulders, boulder zone of reef flat.

Cape Poivre, Barrow I., WAM 3378-68, in beach-rock.

Malaysia:

Palau Langkawi, WAM 80-77, in intertidal basalt.

Solomon Is:

Morau Sound, WAM 93-77, in dead *Porites*, intertidal.

Malaupaina I., WAM 92-77, in dead *Acropora*, 7m.

REMARKS: *L. nasuta* most closely resembles *L. lima*. In fact it seems fairly clear that the mussels from Low Isles which Otter (1937) referred to as *L. cumingiana* included both species, which accounts for the range of habitats to which he attributed his material. Iredale (1939) also failed to observe that there are two "bicoloured" species at Low Isles, and introduced the name *dichroa* to account for Otter's series.

L. nasuta and *L. lima* both have a dark radial ray from the umbos to the postero-ventral margin of the valves and they are of comparable size and shape. However, close inspection will reveal several consistent differences in the shell. The radial purple ray in *L. lima* is due to pigmentation of the shell while in *L. nasuta* the wider, brown radial ray is due to pigmentation of the periostracum and the shell beneath it is plain pale brown.

Generally there are thin, sculptured superficial incrustations posteriorly in *L. lima* but the antero-ventral deposits are usually thin and discontinuous. In *L. nasuta* the posterior incrustations are smooth and there is usually a thick, continuous antero-ventral layer. Finally the postero-dorsal angle in *L. nasuta* is usually more pronounced than in the other species and the umbo is forward-leaning. (See also Lamy (1937) for a comparison of these two species).

Anatomically the two species also have many features in common but invariably they can be easily distinguished by the colour of the siphons. In *L. lima* they are uniformly brown. In *L. nasuta* there is a wide pale band along the posterior edges of the siphons and the two prominent, pale, ciliated pathways in the roof of the incurrent siphon. Also, the ventral partition of the branchial septum is strongly papillose in *L. nasuta* but possesses only low marginal thickenings in *L. lima*.

L. lima and *L. nasuta* are rarely co-inhabitants of the same substrate. The former is common only in living massive corals and rarely burrows in dead coral. *L. nasuta* on the other hand is most common in intertidal beach-rock, reasonably common boring in dead corals in the shallow sublittoral, but never bores in living corals. Only once have I found

the two boring together and this was in the dead centre of a *Porites bomby* in 3 metres in Watson Bay, Lizard I. where I obtained one *L. lima* and a series of *L. nasuta*.

I am unable to agree with the view expressed by Iredale (1939: 421) that the name *L. nasuta* Philippi should be rejected as a *nomen dubium*. It is true that several authors have incorrectly applied the name but the original figure by Philippi does adequately represent the species here considered.

***Lithophaga lima* (Lamy, 1919)**

(Fig. 17 (5-9); text figs. 10-12)

Lithophaga nasuta. — Dunker non Philippi, nec Reeve, 1882: 5, pl. 1, figs. 5, 6, pl. 2, figs. 7, 8.

Dactylus lima 'Jousseume' Lamy, 1919: 256-257. Type locality: Djibouti, Aden. Types: 11 syntypes (Table 6) MNHN (Paris).

DISTRIBUTION: Lamy (1937) reports this species from "Mozambique, Zanzibar, Manille, Japan etc." as well as the Red Sea type locality. Kira (1962) reports it from southern Japan. I have personally collected it at localities in the Philippines, Malaysia, Indonesia, Solomon Islands and northern Western Australia, and in Queensland at Lizard I., Low Isles and Michaelmas Cay. There is also an Australian Museum specimen from Cape Gloucester. Thus it is apparent that *L. lima* is a common species widely distributed in the Indo-West Pacific Region.

HABITAT: *L. lima* normally bores among living polyps of massive corals but it may be found occasionally with its burrow mouth in the dead parts of the corallum. I have collected it boring in living *Porites*, *Favites*, *Favia*, *Pleisiostraea* and *Leptoria*. Gohar and Soliman (1963a) describe its burrows in *Montipora* and occasionally in *Cyphastrea* in the Red Sea. I have collected it from low tide level to a depth of 33 metres.

DESCRIPTION: SHELL: Smooth, thin, and fragile. Internal surface shiny, iridescent, purplish tinted, with a darker purple ray dorsally. Shell exterior white except for a radial (umbonal) purple ray which shows through a thin olive-brown periostracum. More or less cylindrical; umbos sub-terminal; anterior end bluntly rounded, posterior end rounded; ventral margin distinctly convex; dorsal margin (hinge-line) short and straight; postero-dorsal margin straight; dorsal angle moderately sharp and steep.

There is usually an indistinct incised radial line from the umbo to the postero-ventral corner. Ventral to this there is a thin, superficial, granular, calcareous coating which may be discontinuous or cover the whole area. Dorsally in the area adjacent to the hinge and above the radial line the smooth and glossy periostracum is usually not covered by secondary calcareous deposits and the radial purple ray is evident. Postero-dorsally above the radial line there is usually but not always a thick and hard calcareous layer thrown into wrinkled ridges which may be concentric but often tend to become radial and divaricate near the posterior margin. Posteriorly these accretions project hardly at all beyond the end on the valves but they sometimes form a serrated edge there.

Dimensions are given in Table 6.

ANATOMY: The ventral partition of the branchial septum has a low marginal thickening at the centre, and about 6 very small, simple, marginal papillae (Fig. 10). The incurrent and excurrent siphons including the inner and outer surfaces and branchial septum are dark purple-brown. There are scattered white spots close to the inner edge of

Table 6:

Dimensions of syntype series *L. lima* (in mm).

	length	height	width	lig length	A°	B°
1	80.5	25.2	19.7	36.5	22°	11°
2	70.6	22.3	18.9	32.5	23°	13°
3	44.8	16.9	19.4	14.0	28°	18°
4	41.6	15.2	17.0	12.5	32°	16°
5	31.0	11.0	09.7	12.5	27°	13°
6	48.6	19.1	16.4	20.6	29°	16°
7	57.7	18.6	15.0	27.0	20°	12°
8	57.1	18.2	15.3	25.3	22°	15°
9	40.1	14.8	06.3	18.2	27°	12°
10	38.1	13.9	07.1	16.7	22°	14°
11	31.8	11.6	06.1	14.8	28°	15°

v. p. br. sept.



inc. siph.

Fig. 10 *Lithophaga lima* (WAM 96-77). Incurrent siphon opened out and seen from below, illustrating ventral partition of the branchial septum.

the incurrent siphon and two oblique white bands internally. These bands arise from the inner edge of the mantle fold at the branchial septum partition, cross obliquely up the wall of the siphon and converge posteriorly at the outer edge in the mid-line immediately below the excurrent siphon. Application of carmine particles to living animals demonstrated that these white bands mark the position of strongly ciliated rejection tracts which carry particulate matter in mucous strings from the mantle cavity to a rejection point at the mantle edge where periodic expulsion of water from the excurrent siphon carries it well clear of the animal.

The recurrent loop of the rectum reaches the dorsal surface of the posterior adductors as in *L. lessepsiana*. No style was observed in the first arm of the rectum in either preserved or living specimens.

Auricles are pale brown but translucent and not heavily pigmented. Pericardial glands are not apparent on the auricles or the pericardial floor. In other respects the heart is like that of *L. teres*.

Plicate canals in the supra-branchial chamber are lacking. Instead there is an axial series of deep supra-branchial pockets between the gill axis and the visceral mass along each side. Like *L. lessepsiana*, the largest of these pockets are the ones in which the renal and genital apertures are situated, directly below the antero-lateral corners of the pericardium. They also have compressed anterior extensions into the visceral mass. *L. lima* differs from *L. lessepsiana* however, in that the series of smaller supra-branchial pockets continues posteriorly as far as the posterior retractors (Fig. 11). There are 6-8 supra-branchial pockets in front of the large central one, becoming progressively smaller anteriorly, and 8-10 small posterior pockets.

Genital and renal apertures are located as in *L. lessepsiana* (Fig. 11).

Gonad tubules, when in ripe condition, spread superficially over the digestive gland anterior to the pericardium, fill much of the space in the visceral mass below and behind the pericardium, and fill the mantle lobes. The mesosoma is small and contained no gonad in the ripe specimens examined. Ovary is purple, testis is white.

The kidneys comprise diverticulate, massed, pale-green tubules along the length of the gill axes as in *L. lessepsiana*.

The ctenidia are like those of *L. lessepsiana* having inter-lamellar septal membranes between the ascending and descending lamellae, spaced at intervals of 4-6 filaments along the gills.

There is a narrow band of muscle on each side arising separately from the pedal muscles just anterior to the posterior retractors and attaching to the shell lateral to the posterior end of the pericardium. Radial pallial muscles are well developed posteriorly but a distinct siphonal retractor is not evident.

Labial palps are short, stout and only finely plicate on their inner faces. The outer pair are slightly longer than the inner pair.

ANATOMICAL MATERIAL EXAMINED.

Queensland:

Watson Bay Lizard I., WAM 111-77, in *Porites*.

North Point, Lizard I., WAM 95-77, in *Leptoria*.

Rocky Point, Lizard I., WAM 96-77, in *Porites*.

Rocky Point, Lizard I., WAM 100-77, 97-77, in dead coral rock.

Rocky Point, Lizard I., WAM 99-77, in *Favia*.

Low Isles, WAM 98-77, in *Leptoria*.

Michaelmas Cay, WAM 107-77, in *Porites*.

Western Australia:

Kendrew I., Dampier Archipelago, WAM 109-77, in *Pleisiastraea* (?).

Solomon Is.:

Malaupaina I., WAM 110-77, in *Favites* at 33 metres.

Malaysia:

Palau Langkawi, WAM 37-73.

REMARKS: The identity of this species has been badly confused in the literature because of the similarity of the shell with that of *L. nasuta*. Lamy (1937) discusses the differences

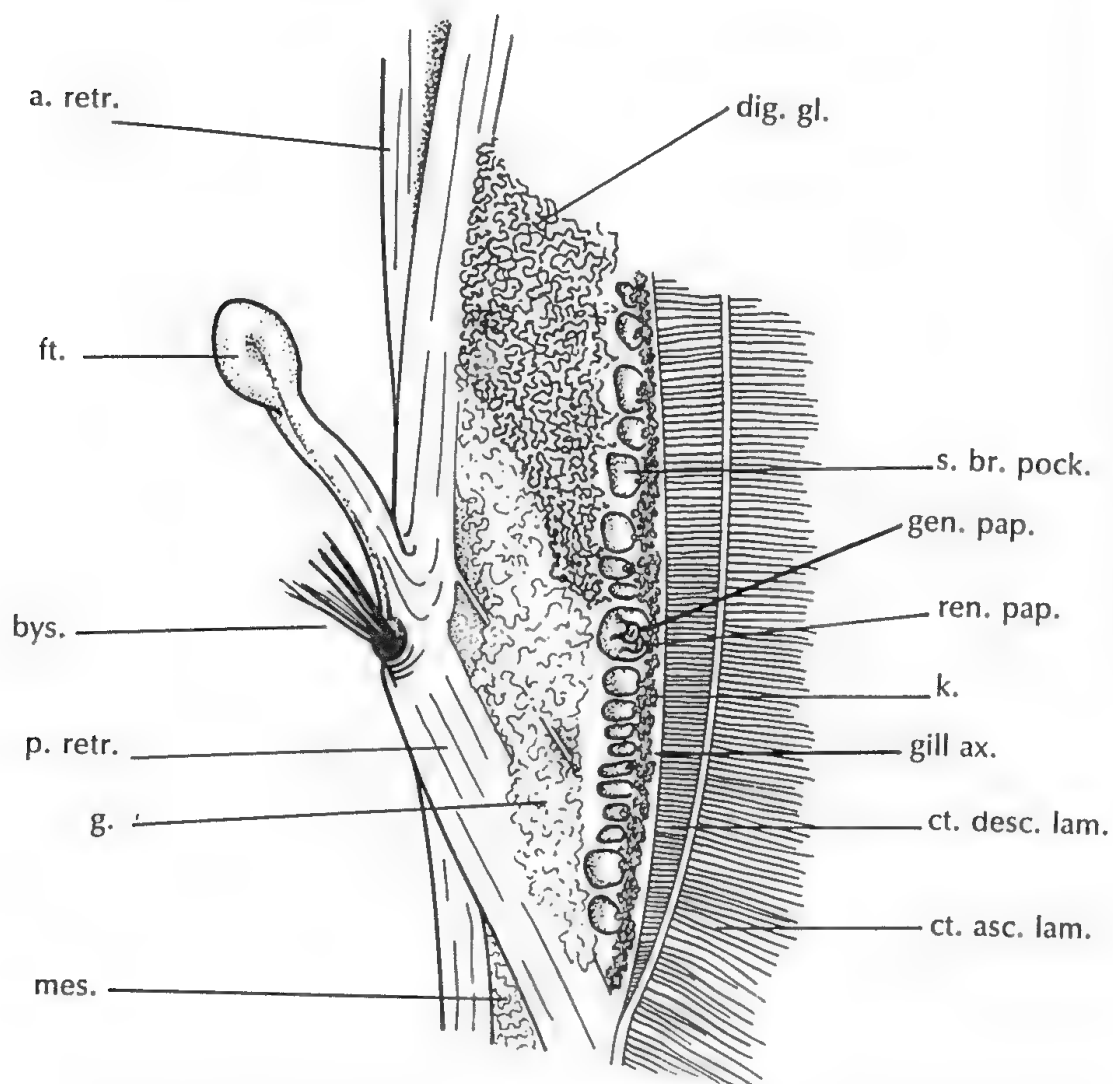


Fig. 11 *Lithophaga lima* (WAM 96-77). Roof of mantle cavity of right side illustrating the series of supra-branchial pockets and the location of renal and genital apertures.

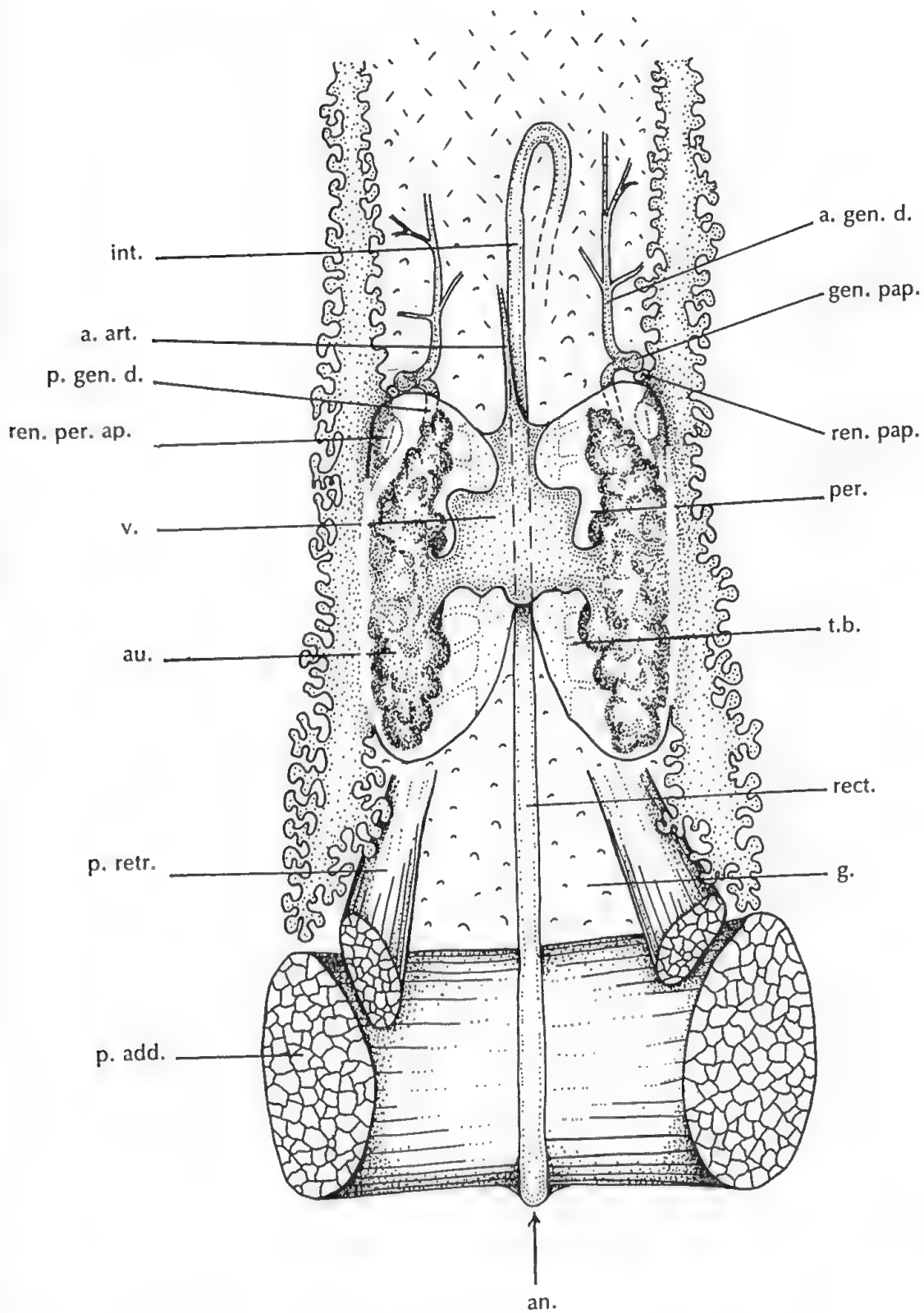


Fig.12 *Lithophaga lima* (WAM 96-77). Diagram illustrating relationships of heart, gut and posterior muscles as seen in dorsal view.

between the two species. Further discussion may be found in the remarks made here under *L. nasuta*.

The radial purple ray on the exterior of the shell is a unique character among the Indo-West Pacific lithogpagids.

***Lithophaga malaccana* (Reeve, 1858)**

(Fig. 18 (4-5); text fig. 13)

Lithodomus malaccanus Reeve, 1858: pl. 4, fig. 10. Type locality: Malacca. Syntypes: BM (NH) Regn. no. 1975104.

Lithophaga cavernosa Dunker, 1882: 7, pl. 5, figs. 15,16. Type locality: Philippines. Type: not located.

Lithophaga reticulata Dunker, 1882: 19, pl. 5, figs. 9-10. Type locality: Java, ? Type: not located.

Lithophaga calcifer Iredale, 1939: 420-421, pl. 6, fig. 28. Type locality: Low Isles, Qld. Holotype: AM regn. no. C60402.

DISTRIBUTION: Common throughout the Indo-West Pacific. In the Australian Museum and Western Australian Museum collections it is represented from the following Queensland localities: Lizard I., Low Isles, Michaelmas Cay, Lindeman I., Bowen, Humpy I., N. Keppel I., Heron I., Masthead I., Fairfax I., Swain Reefs, Port Curtis, and Moreton Bay. I have also personally collected it at a number of localities in the Philippines, Malaysia, Indonesia, Solomon Islands and northern Western Australia. Gohar & Soliman (1963b) report it from the Red Sea.

HABITAT: Iredale (1939) asserts that this species (i.e. *calcifer*) "was found in living *Favia*, *Goniastrea* and *Pocillopora*, as well as in dead coral boulders" but in my own experience it only occurs in dead corals or in the dead parts of living colonies. Gohar & Soliman (1963b) report it only from dead corals. In many localities it occurs in enormous abundance and its boring activity must play a major role in the breakdown of hard coral to calcareous silts. *L. malaccana* is common from low water spring tide level to at least 35m. Gohar & Soliman (1963b) describe the burrows.

DESCRIPTION: SHELL: Smooth, thin and fragile. Internal surface shiny and fawn or light brown with a paler umbonal ray marking the position of the external sulci; exterior with a thin yellow-brown periostracum. Cylindrical; umbos sub-terminal; anterior end broadly rounded, posterior end broadly rounded or truncate; ventral margin straight to slightly convex; dorsal margin (hinge-line) long and straight; postero-dorsal margin straight; dorsal angle rather sharp but relatively low, (about 31-35°), dorsal and ventral margins almost parallel. Ratio of height to length very variable, sometimes even within a sample from the same coral head, ranging from 0.33 to 0.28.

Tightly adhering crusty calcareous accretions superficially cover the exterior except at the umbos and along the hinge-line. There is a distinct radial umbonal sulcus from the umbo to the postero-ventral margin, and a second, less distinct sulcus a little higher from the umbo to the postero-dorsal margin. Between the sulci is a wedge-shaped area in which the accretions are thick and cast into divaricating and inter-twining wrinkles or ridges giving the surface a deeply pitted appearance. Toward the posterior extremity these ridges are raised high, thin and foliose or vertically lamellose. In this area the accretions are

especially thick and project far beyond the ends of the valves. The projections are convex and sculptured on their outer sides, and more-or-less flat but dentate on their inner sides. Antero-ventrally, i.e. below the deeper umbonal sulcus, the calcareous accretion is relatively thin, uniform and smooth though granular. On the narrow dorsal slope above the lesser sulcus the accretion is thin and smooth.

Dimensions are given in Table 7.

ANATOMY: The cup-shaped ventral partition of the branchial septum is papillose along its margin. The central lappet is the largest, sometimes bifid (Fig. 13), and bears 3 to 5 finger-like papillae on each side. There are branched lateral lappets in the corners and 2 or 3 small, simple, intermediate papillae on each side flanking the central lappet.

Internally the incurrent siphon, including the branchial septum and its ventral partition, is translucent-white, abundantly flecked with prominent opaque white spots and rectangular and linear marks. The margins of both the incurrent and excurrent siphons are light brown internally and externally.

The first loop of the rectum turns just anterior of the posterior adductor muscle. No style was observed in the first arm of the rectum of either preserved or living specimens.

Auricles are thin, transparent and not pigmented. Pericardial glands are not evident on the floor of the pericardium.

Plicate canals are lacking in the supra-branchial chamber but there is a single axial series of deep pockets between the gill axis and the visceral mass along each side. The largest pocket lies directly below the antero-lateral corners of the pericardium. There are about 13 pockets in the series anterior to the large one but more behind. In these respects *L. malaccana* is most like *L. lessepsiana*, but in this species there appears to be no anterior extension of the large supra-branchial pockets into the visceral mass.

The genital apertures are located on papillae in the roof of the large pair of supra-branchial pockets. Renal apertures were not observed but are assumed to be located immediately lateral to the genital papillae as in the other species.

Table 7

Dimensions of *L. malaccana* (in mm)

	length	height	width	lig length	A°	B°
Syntype <i>L. malaccana</i>	25.1	10.3	—	—	—	—
Holotype <i>L. calcifer</i>	36.7	12.9	10.6	19.2	16°	7°
Topotypic series	33.2	11.1	08.2	17.8	23°	9°
<i>L. calcifer</i> ex Low Is.					25°	10°
(WAM 460-76)	29.4	10.4	08.0	13.1	25°	9°
	28.9	10.3	09.4	14.2	21°	8°
	28.8	09.1	07.8	12.5	24°	11°
	25.2	08.5	06.9	10.8	25°	11°
	22.5	06.3	02.5	09.8		

Gonad tubules, when in ripe condition, spread superficially over the digestive gland just anterior to the pericardium, fill much of the space below and behind the pericardium, and fill the mantle lobes. There is no gonad in the small mesosoma. Ovary is chocolate-brown. Testis is white.

On the surface of mantle lobes when the shell valves are removed, two major dendritic genital duct systems, one anterior and one posterior, may be seen converging in the area above the genital aperture. They join other major anterior and posterior ducts from the visceral mass.

The kidneys are pale-green, lying along the length of the gill axes as in *L. lessepsiana*.

Ctenidia were not examined.

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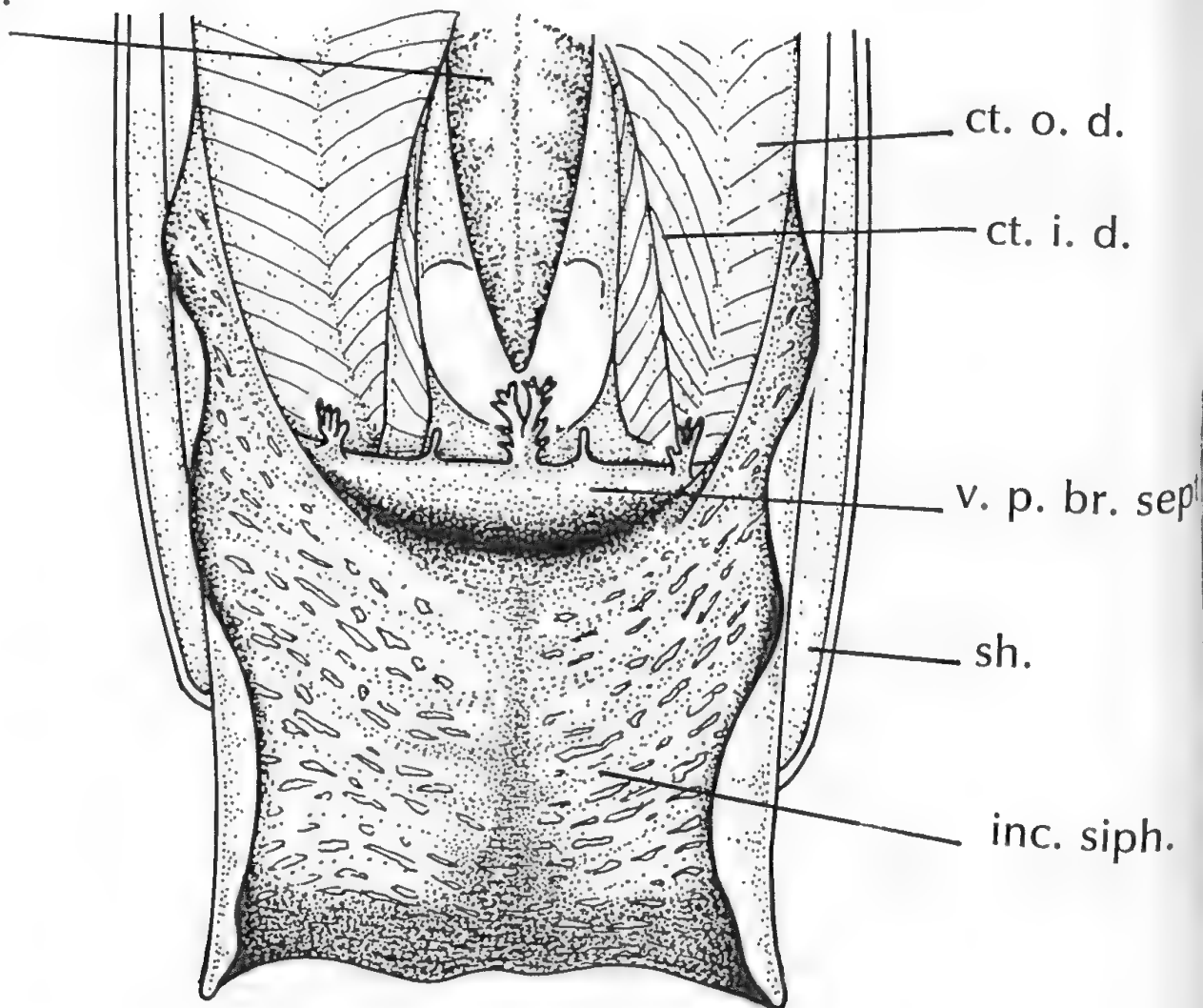


Fig. 13 *Lithophaga malaccana* (WAM 125-77). Incurrent siphon opened out and seen from below, illustrating the ventral partition of the branchial septum.

ANATOMICAL MATERIAL EXAMINED:

Queensland:

Low Isles, WAM 460-76, 130-77, in dead head of *Porites*, intertidal.

Lizard I., Rocky Point, WAM 125-77, in dead coral rock.

Heron I., south side, WAM 133-77, 134-77, 137-77, 140-77, dead coral slab, outer reef rim.

Heron I., south east side, WAM 136-77, dead coral boulders, reef crest.

Western Australia:

Kendrew I., Dampier Arch., WAM 169-77, in dead parts of coral heads, 2m.

Fiji:

Suva Bay, Viti Levu, WAM 116-77, in barnacle-covered lithothamnion rock, high intertidal zone.

Solomon Islands:

W. side Malaupaina I., WAM 113-77, dead parts of *Favites* ca 33m depth, outer reef slope.

Malaupaina I., WAM 132-77, 112-77, dead *Acropora* on sandy slope, 7m, lagoon entrance channel.

Malaysia:

P. Gasing, off Tg Rhu, Palau Langkawi, WAM 38-73.

REMARKS: I have compared the types of *malaccana* and *calcifer* and am satisfied that they are conspecific. In each case thick, wrinkled and pitted calcareous accretions are present in a wedge-shaped area between two narrow radial umbonal sulci, and the accretions project far beyond the ends of the valves. Dunker's types of *reticulata* and *cavernosa* appear to be lost but his figures seem best referred to this species.

Though shells of this species are unusually variable both in shape and the extent and nature of the posterior accretions, colouration of the siphons is consistent in all the living material I have examined. Shells could perhaps be confused with those of *L. lessepsiana* from *Porites* in which dentate, projecting posterior incrustations may be present. However, in *L. lessepsiana* the siphons are cream or fawn externally except for a broad brown band a short distance forward of the margin; internally the incurrent siphon is brown except for pale margins and pale converging lines marking the position of ciliated rejection tracts. The siphons of *L. malaccana* are conspicuously different; in this species they are pale internally and externally except for the posterior margins which are brown. In many other respects the anatomy of *L. malaccana* and *L. lessepsiana* are similar and there can be little doubt that they are closely related species.

Lithodomus laevigatus Quoy & Gaimard, 1835 (type locality: Port Dorey, New Guinea) could be this species as the 2 syntypes (deposited in the MNHN (Paris)) possess similar posterior encrustations (Fig. 18(3)). But the syntypes are badly damaged and could equally be *L. lessepsiana* from a *Porites* host. Because of the poor condition of the types and lack of any anatomical data I suggest that *L. laevigatus* should be regarded a *nomen dubium*.

The calcareous accretions and the radial umbonal sulci of *L. malaccana* closely resemble those of the American species *L. (Diberus) bisulcata* (d'Orbigny, 1842) and *L. (Diberus) plumula* (Hanley, 1843) and there is little doubt that future anatomical data will confirm a close affinity between them.

***Lithophaga hanleyana* (Reeve, 1857)**

(Fig. 17 (3-4); text fig. 14)

Lithodomus hanleyanus Reeve, 1857: pl. 4, fig. 19. Type locality: Suez. Types: BM (NH), 3 syntypes, 2 broken including specimen marked "X" which is probably the one figured by Reeve.

Lithophaga laevigata instigans Iredale, 1939: 422, pl. 6, fig. 27. Type locality: Low Is., Qld. Type: AM regn. no. C60405.

DISTRIBUTION: Apparently widely distributed in the Indo-West Pacific though locality records are few. In Queensland I have collected *L. hanleyana* only at Low Isles and Heron I., and there are no other specimens in the AM or WAM collections from Australian localities. However, I found it common at Malaupaina I. in the Solomons and have also collected it at Polillo I., east coast of Quezon, Philippines. There are AM specimens from Funafuti and Tupuselei, Papua New Guinea. Gohar & Soliman (1963a) record the species from the Red Sea but I am doubtful that their specimens were correctly identified.

HABITAT: *L. hanleyana* burrows in dead coral and coral rock, perhaps preferring sheltered back-reef and lagoon situations. At Malaupaina I., Solomon Is, I found it in abundance boring in a dead colony of a thick-stemmed *Acropora* species in sheltered conditions at a depth of 6 metres in the lagoon entrance, and again fairly riddling a slab of coral rock laying among sea-grass in the intertidal zone of the lagoon itself. In the latter case the burrows were vertical with the openings on the underside of the slab.

DESCRIPTION: I did not collect this species at Lizard I. and the following description is based on material from Heron I.

SHELL: Smooth, thin and moderately fragile. Interior surface shiny and iridescent, sometimes with greenish and purple tints; exterior white with a thin light olive-green to brown periostracum. Cylindrical; umbos sub-terminal; anterior end bluntly rounded, posterior end truncate but with rounded corners; ventral margin slightly convex, almost straight; dorsal margin (hinge-line) short, straight; postero-dorsal margin straight; dorsal angle well developed but low.

There is a shallow umbonal sulcus from the umbo to the postero-ventral corner and a wide deeper one dorsally which may sometimes delineate a postero-dorsal "wing". Antero-ventrally the shell is covered by a thick, solid and smooth calcareous layer. On the dorsal wing the calcareous layer is thin and usually discontinuous so that the periostracum is visible there. Along the hinge-line dorsally solid calcareous covering is lacking but there is a loose calcareous pasty layer.

Posteriorly in the triangular area between the two sulci the accretions are solid and thick, usually smooth but sometimes weakly pitted, and protrude far beyond the ends of the valves. The projections are sharp and chisel-like at their posterior edges and may be truncate or pointed medially; sometimes they are curved upwards. Their outer side is convex but the inner side is flat (i.e. in the sagittal plane).

ANATOMY: The ventral partition of the branchial septum is colourless or very light brown and translucent. Its edge is usually entire (lacking digitations) except for a single broad triangular medial flap (Fig. 14a) but may be serrate (Fig. 14b) or filamented (Fig. 14c). Inner and outer surfaces of the two siphons are brown, conspicuously blotched with thick white spots, sometimes almost colourless becoming brown toward the posterior margins.

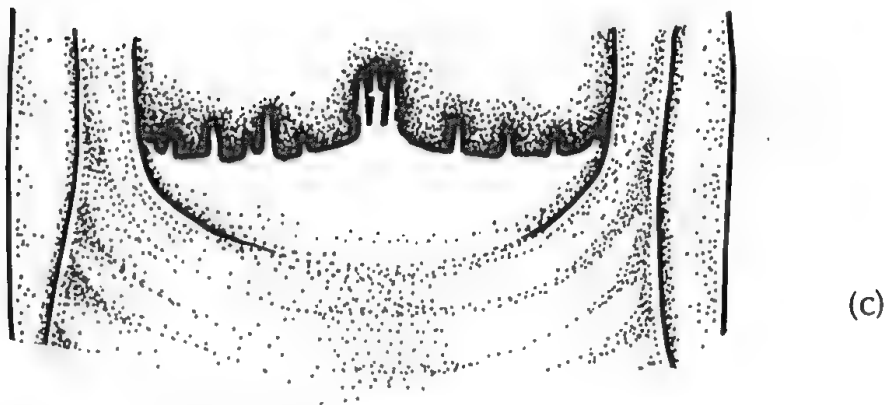
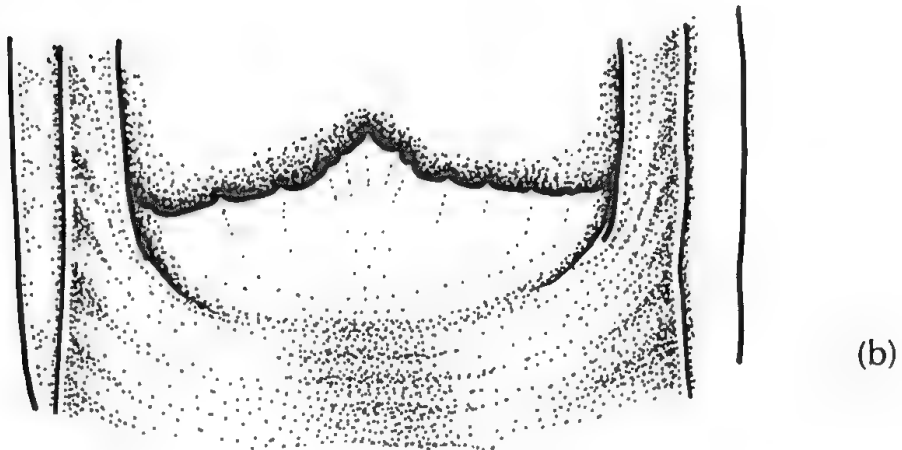
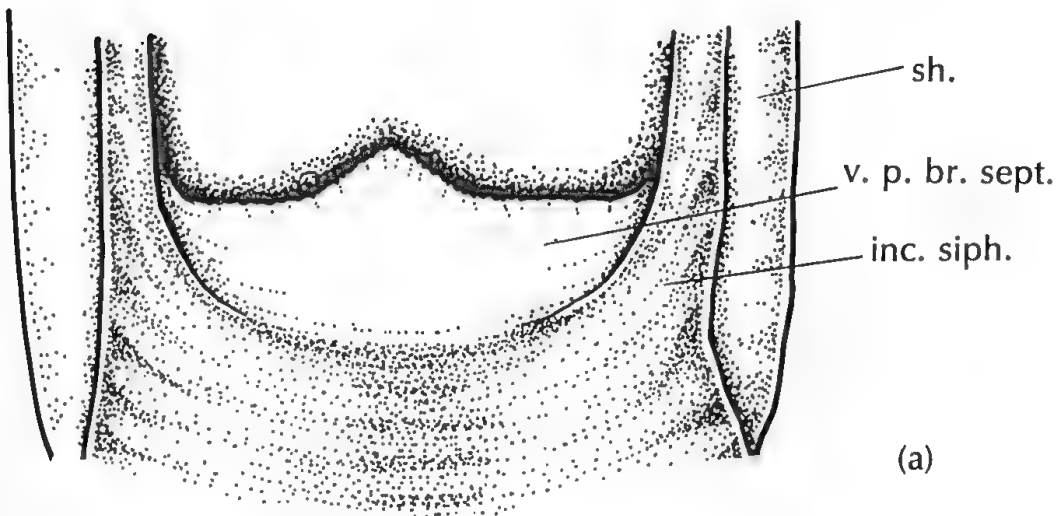


Fig. 14a, b, c *Lithophaga hanleyana* (WAM 221-77). Incurrent siphon opened out and seen from below, illustrating the ventral partition of the branchial septum.

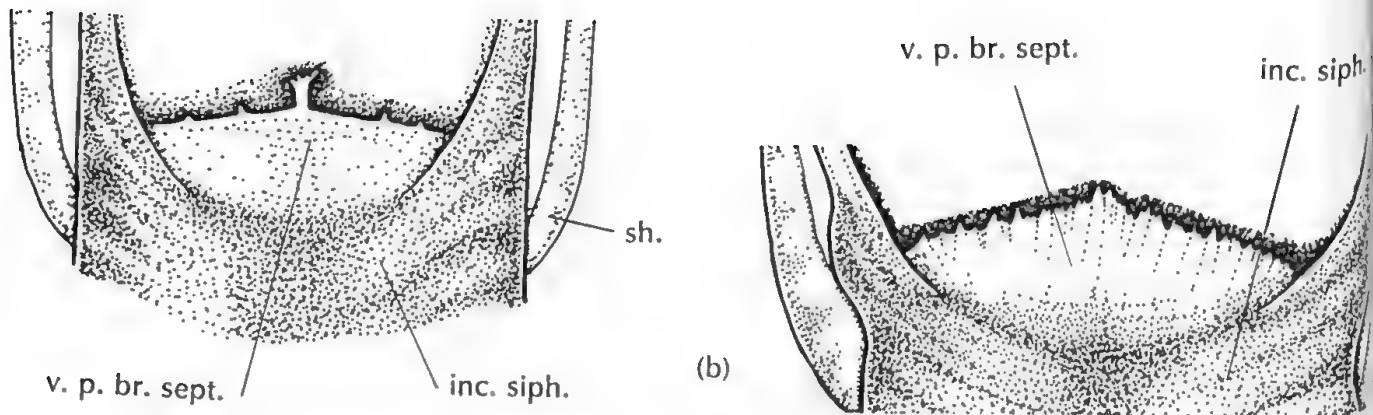


Fig. 15 *Lithophaga obesa*. Incurrent siphon opened out and seen from below, illustrating the ventral partition of the branchial septum.

15a Lizard I., Qld (WAM 148-77).

15b Dampier Arch., W.A. (WAM 151-77).

Digestive gland is light olive-green.

The first loop of the rectum reaches only as far as the posterior end of the pericardium.

Auricles are thin, transparent and lack pigmentation.

Plicate canals are lacking between the visceral mass and the gill axes. Instead there are axial series of deep supra-branchial pockets as in *L. lessepsiana*, with about 13 in each series, the largest being the posterior pair which have deep visceral diverticulae.

Genital and renal papillae are located on the walls of the most posterior supra-branchial pockets as in *L. lessepsiana*.

Gonad tubules fill the mantle lobes and some of the space between the posterior retractor muscles but, in the specimens examined, there is no mesosoma. Testis is white, ovary puce.

Kidneys as in *L. lessepsiana* but colourless.

Ctenidia as in *L. lessepsiana* but inter-lamellar septae are spaced 5 to 8 filaments apart and reach a height of only about a quarter of the gill height.

ANATOMICAL MATERIAL EXAMINED.

Queensland:

Heron I., WAM 221-77, in beach-rock, low intertidal zone.

Heron I., WAM 34-73, in dead coral boulder, outer reef rim.

Heron, I., WAM 210-77, in dead *Porites* on reef flat.

Philippines:

Polillo I., Quezon, WAM 208-77, in limestone rocks, low tide.

REMARKS: The thick, smooth and projecting posterior incrustations suggest that this species may be most closely allied to the several American species generally associated in the subgenus *Labis*.

I have compared Reeve's types of *L. hanleyana* with Iredale's types of *L. laevigata instigans* and believe them to be conspecific. The smooth posterior incrustations of the latter compare well with those still preserved on the types of *L. hanleyana* and are very different to the pitted and toothed structures so characteristic of *L. malaccana*.

Gohar & Soliman (1963a) record *L. hanleyana* from the Red Sea but I am doubtful about the identity of their material. Their photographic illustrations (Pl. 1, fig. 1 centre) are like the type and the specimens described here but their line drawings (Text-figs. 8, 9) and descriptions of the shell appear to represent another species, possibly *L. lima*. They report the species boring almost exclusively in living corals (*Cyphastrea*, *Montipora*, *Goniastrea*) which also suggests a misidentification.

***Lithophaga divaricalx* Iredale, 1939**

(Fig. 18 (1))

Lithophaga divaricalx Iredale, 1939: 420, pl. 6, fig. 23. Type locality: Low Isles, Qld. Holotype: AM regn. no. C60401.

DISTRIBUTION: This species appears to be uncommon. The type specimen is the only one of the species I have seen from Qld. In the WAM there are 2 additional samples which come from off Peak I., northern W.A. and Quezon, Philippines respectively, suggesting a central Indo-West Pacific distribution.

HABITAT: There is no information about the site of collection of the Low Isles type specimen. The two WAM samples were removed from dead coral rock. The W.A. sample was dredged from a depth of 20 metres; the Philippine sample was collected by a diver at a depth of 2 metres.

DESCRIPTION: SHELL: Smooth, moderately thin. Internal surface iridescent, purplish below the umbos, exterior whitish, covered by a smooth light yellow-brown periostracum. Umbos sub-terminal; anterior and posterior ends broadly rounded; ventral margin convex; dorsal margin (hinge-line) straight and rather long; postero-dorsal margin short and straight; dorsal angle steep and well defined. Ligament length greater than half the shell length. There is a broad radial sulcus from the umbo to the postero-ventral corner, and a well defined postero-dorsal wing.

The whole of the ventral area below the radial sulcus is covered with a thick, uniformly granular calcareous incrustation. On the postero-dorsal wing there is a thinner but also uniform calcareous layer arranged in concentric granulose cords which follow the growth striae of the shell. In a wide radial ray immediately dorsal to the radial sulcus is an area of very thick incrustation cast into raised chevron-shaped ridges which tend to become rough and irregular posteriorly; at the posterior end the incrustations project several mm beyond the ends of the valves.

Dimensions are given in Table 8.

ANATOMY: The two samples available (WAM 314-77, 84-63) are poorly preserved and colourless. I can determine only that the ventral partition of the branchial septum is ornamented by a digitate, rectangular, central lappet, and that there are supra-branchial pockets between the visceral mass along the whole length of the gill axes as in *L. lima*.

REMARKS. *L. divaricalx* appears to be closely related to *L. pessulatus* Reeve, 1857. The only specimen of the latter species known to me is the probable holotype in the collections of the British Museum (Nat. Hist.) (regn. no. 197593). Mrs Solene Whybrow has kindly sent illustrations (Fig. 18(2)) of the Reeve specimen and the following descriptive notes:

Table 8.

Dimensions of *L. divaricalx* shells (in mm)

	length	height	width	lig length	A°	B°
Holotype	40.6	22.5	14.9	22.6	39°	15°
Philippines (WAM 314-77)	27.7	11.4	09.9	15.4	40°	13°
Peak I, W.A. (WAM 84-63)	37.5	16.1	14.0	22.1	35°	16°
Peak I, W.A. (WAM 84-63)	29.9	11.9	09.3	15.4	39°	14°

"Length 3.95cm; height at broadest point 1.16cm. Specimen articulated, ventrally separated. Anterior end of LV broken away. Shell strongly eroded at anterior end; where remaining, periostracum is chestnut brown. Calcareous outer covering is dirty white extending about 5mm (4.75mm) beyond posterior end of shell, is approximately 2 mm thick at shell margin and marked on the inside at its junction with the shell margin by small teeth like ridges.

Exteriorly the pattern of this calcareous covering is slightly abraded and appears only superficially similar to *L. divaricalx* Iredale (from your photo) in the posterior area. Ventrally it is distinguished by raised "ribs" of calcareous material approximately perpendicular to the hinge axis."

From these data I conclude that *L. pessulatus* Reeve is probably not conspecific with *L. divaricalx* Iredale but a larger series of shells, and observations on anatomy of both forms are needed.

There is little doubt that *L. divaricalx* is distinct among the Queensland lithophagids. The thick posterior incrustations are most like those of *L. malaccana* but in the small series available to me the chevron ridges are consistent and quite different to the granulose or wrinkled sculpture of the latter species.

The shape of the shell resembles that of *L. lima* but the more prominent postero-dorsal wing and steeper dorsal angle distinguish *L. divaricalx*. In *L. lima* the ligament length is less than half the total shell length while in *L. divaricalx* it is greater than half, and again the strong chevron sculpture of *L. divaricalx* is distinctive. The few data on the habitat of *L. divaricalx* indicate that it bores in dead coral whereas *L. lima* is most commonly found in living massive corals.

***Lithophaga obesa* (Philippi, 1847)**

(Fig. 17 (1); text fig. 15).

Modiola (Lithophagus) obesa Philippi, Aug. 1847: 118. Type locality: China? Figured Philippi, Sept. 1847: pl. 2, fig. 2. Type: Not located. Neotype here nominated is the holotype of *L. obesa suspecta* Iredale, 1939.

Lithophaga obesa suspecta Iredale, 1939: 422, pl. 6, fig. 30. Type locality: Low Isles, Qld. Holotype: AM regn. no. C60407.

DISTRIBUTION: Widely distributed throughout the Indo-West Pacific. It occurs in northern W.A. (Dampier Archipelago) and down the east coast of Australia as far as Coffs Harbour, NSW. In AM and WAM collections *L. obesa* is represented from the following Qld. localities: Lizard I., Low Is., Dingo Beach, Lindeman I., Heron I.

HABITAT: *L. obesa* usually burrows in coral rock. Otter (1937) shows that it is most common in boulders on the reef front and reef slope at Low Isles but also occurs in intertidal boulders in the boulder tract zone and on the reef flat. At Heron I. and at Kendrew I., Dampier Archipelago, W.A. it has a similar ecological distribution. In these wave-beaten situations burrows of this mussel will be found on the sides and undersides of the boulders. In the first case the burrow is horizontal and in the latter case it is vertical with the opening facing downwards. At Lizard I. where there are no exposed reef flats I found *L. obesa* burrowing in the dead centre of a *Porites bomby* in the lagoon sublittoral (3 metres), and in this situation the burrow was vertical with the opening facing upwards. At Watson Bay a single specimen was extracted from among living polyps of a large massive coral head (probably *Cyphastrea*) at a depth of 3 metres.

The mouth of the burrow is very large (up to 6cm long), has the typical hour-glass shape, and a thick, hard calcareous lining.

DESCRIPTION: SHELL: Large, smooth, moderately thin. Exterior buff, with a uniform light yellow-brown periostracum; interior iridescent. Elongate-ovate, slightly attenuate anteriorly, tumid. Umbos large, sub-terminal or terminal; anterior end curved but sloping, posterior end rounded; ventral margin strongly convex; dorsal margin (hinge-line) straight; postero-dorsal margin slightly convex; dorsal angle not pronounced.

There is usually a weak radial sulcus from the umbo to the postero-ventral margin demarcating the antero-ventral and postero-dorsal areas, and sometimes another weaker one a little below the hinge-line. There is usually a thin, discontinuous, smooth chalky covering layer on the antero-ventral area; above the umbonal sulcus there is a thin, discontinuous, granulose, chalky layer which becomes thicker and more even posteriorly but does not extend beyond the ends of the valves.

Dimensions are given in Table 9.

Table 9.

Dimensions of *L. obesa* shells (in mm)

	length	height	width	lig length	A°	B°
Neotype	81.7	28.3	20.1	37.1	24°	17°
Heron I., Qld. (WAM 32-73)	29.6	13.2	10.0	13.9	29°	23°
Yeppon, Qld. (WAM 150-77)	69.1	26.3	22.1	33.2	28°	18°
Kendrew I., W. A. (WAM 151-77)	108.5	35.1	27.1	48.5	20°	18°
Kendrew I., W.A. (WAM 151-77)	86.9	30.9	23.1	39.2	22°	21°

ANATOMY: The siphons are very large in this species and tend to turn downward at the posterior end. They are dark brown inside and out, becoming even darker at the posterior margins.

The ventral partition of the branchial septum is thick; muscular and dark brown. Its edge is normally irregularly serrate along its whole length with the largest, rather compressed-triangular serrations at the centre (Fig. 15). Occasionally the edge may be entire except for a small branched digit centrally.

Digestive gland is light olive-green.

The first loop of the rectum reaches far back between the posterior retractors almost to the front edge of the posterior adductor.

Auricles are thick, opaque and dull orange.

Plicate canals are lacking between the visceral mass and the gill axes but axial series of deep supra-branchial pockets are present there. The largest of these is located below the antero-lateral corner of the pericardium and possesses a deep antero-dorsal extension into the visceral mass. Pockets occur both anterior and posterior to the large central ones as in *L. lima*.

Genital and renal apertures are located on small papillae in the large central supra-branchial pocket as in *L. lessepsiana*.

Gonads fill the mantle lobes and a small mesosoma and spread superficially over the visceral mass as in *L. lessepsiana*. The specimens examined were all male and the testis is white.

Kidneys as in *L. lessepsiana*.

Ctenidia are like *L. teres* and unlike *L. lessepsiana* in that the inter-lamellar connections are simple bars not septae.

ANATOMICAL MATERIAL EXAMINED.

Queensland:

Watson Bay, Lizard I., WAM 148-77, in live *Porites* in 3 metres.

Lagoon, Lizard I., WAM 149-77, in dead *Porites*, intertidal.

S. side Heron I., WAM 32-73, in dead coral slab, reef outer edge, intertidal.

Western Australia:

Kendrew I., Dampier Archipelago, WAM 151-77, in sides of limestone boulder, reef crest, intertidal.

DISCUSSION

The nine species of *Lithophaga* listed and described here from Queensland waters are shown to be widely distributed in the tropical Indian and Western Pacific Oceans and it seems likely that they comprise the majority of the lithophagine fauna of the region as a whole. One species, *L. teres*, has a very close relative, *L. nigra*, in the tropical Western Atlantic. Another species, *L. antillarum*, itself occurs in the tropical Western Atlantic as well as in the Indo-West Pacific.

In the central Indo-West Pacific Region (including northern Australia) on any shore rich in corals and calcareous rocks at least six species of *Lithophaga* will be common, though they exhibit some degree of habitat specialization.

DEPTH DISTRIBUTION

Intertidal. All species except *L. divaricalx* are recorded from the intertidal zone. *L. nasuta* and *L. malaccana* are found highest on the shore. Where there is an intertidal notch or rocks at the inner part of a coral or limestone reef these two species are usually found together high in the intertidal zone boring in the oyster mass or the rock itself if it is calcareous. *L. teres* may also occur there but not usually abundantly. *L. obesa* sometimes occurs boring in vertical or overhanging walls of the lower notch if there is exposure to strong wave action.

Where there is a beach with sloping or near horizontal beach rock in the upper intertidal zone *L. nasuta* is usually abundant but *L. teres* and *L. malaccana* are not found in that situation.

On the inner reef flat *L. teres* and *L. malaccana* are usually the abundant species boring in coral or other calcareous boulders. *L. hanleyana* may also occur there though perhaps more often in deeper pools or other sheltered situations.

On the outer reef flat where there is a boulder tract slightly higher than the main reef flat the boulders will be heavily bored by *L. teres*, *L. malaccana* and *L. nasuta*. On the sides and undersides of larger boulders *L. obesa* may also occur in this zone. The only ecological information I have for *L. antillarum* is based on a single specimen from a boulder in the intertidal boulder tract at Heron I.

The two species which bore in living corals, *L. lima* and *L. lessepsiana* may be common in appropriate corals at the lower inter-tidal levels of the reef front slope and in reef flat pools.

Sublittoral. All 9 species extend well down into the sublittoral except *L. nasuta* which is rarely found below a depth of a few metres.

In the sublittoral zone *L. malaccana* is usually the most abundant species boring in dead corals though *L. teres* is perhaps more widely distributed. Both these species extend well down the reef-front slope. I have collected *L. malaccana* in coral rocks at 35 m on a reef-front slope in the Solomons. I have taken *L. teres* from a dead coral boulder at a depth of 50m in the Solomons and from calcareous lithothamnion nodules dredged at 66 m off the W.A. coast.

L. hanleyana and *L. obesa* are also found boring in coral boulders and rock in the sublittoral but I have insufficient data to comment on their depth range. The only available data for *L. divaricalx* suggest that it too bores in coral rock in the sublittoral.

L. lima and *L. lessepsiana* are frequently common in suitable living corals on exposed reef front slopes and in lagoons to depths of at least 10 m which is the zone where their favoured colonial host corals begin to thin out. I have collected *L. lima* in *Favia* at a depth of 33m down a reef-front slope in the Solomons. Arnaud & Thomassin (1976) record *L. lessepsiana* burrowing in the basal parts of the free-living coral *Heteropsammia michelini* on soft substrates at 95m.

The ability of *L. lessepsiana* and *L. lima* to bore among living coral polyps is remarkable. It poses many questions about the settlement and post-settlement behaviour of the larval stages. A curious point is that although *L. lima* is occasionally found with its burrow mouth in the dead parts of a corallum this is apparently never the case with *L. lessepsiana*. It seems that the latter species is not just capable of living among the living polyps of its host but is obliged to do so. Arnaud & Thomassin (1976) proposed that the mussels are killed by the growth of calcareous algae after death of the coral host, but this is not the case with other species of *Lithophaga*.

Another curiosity is that both mussels are found only in certain kinds of coral. *Lithophaga lima* bores in a number of living massive corals but apparently not in any branching forms. *L. lessepsiana* lives in colonies of *Acropora palifera* but not in other species of that genus and in colonies of *Pocillopora eydouxi* but apparently not *P. damicornis* which is usually the more abundant species of *Pocillopora* present. It lives in some species of *Favia* and *Porites* but apparently not in other massive corals. It burrows in *Heteropsammia michelini* but apparently not in other species of that genus or related free-living genera. Arnaud and Thomassin (1976) propose that "boring into the coral is favoured by the structure of the coral branches: dense at the surface, but light within". The relationships of *L. lessepsiana* and *L. lima* to their coral hosts would make fascinating studies.

The anatomical data presented here indicate that major changes are necessary in the generic classification of lithophagines. Among the Indo-West Pacific series *L. teres* and *L. antillarum* stand well apart from the others. They have sculptured shells and lack superficial calcareous incrustations. Blocking the burrow mouth is apparently achieved by apposition of the thickened, lip-like ends of the shell itself while in some other species the posterior incrustations form a plug. There are also several major anatomical differences. In *L. teres* there are plicate canals between the visceral mass and the gill axes like those described in *Mytilus*. The single specimen of *L. antillarum* has no plicate canals but it has no supra-branchial cavities pockets either and the genital and renal papillae are situated on the roof of the supra-branchial chamber as they are in *L. teres*. In the other Indo-West Pacific lithophagines, plicate canals are lacking and there is instead a series of deep pockets or cavities along the roof of the supra-branchial chambers in that position. The largest of these supra-branchial pockets are located immediately below the antero-lateral corners of the pericardium and the genital and renal apertures are located on contiguous papillae on their walls. In *L. teres* and *L. antillarum* there is a block of hard amorphous tissue in the roof of the dorsal cul-de-sac of the mantle cavity, i.e. in the mantle lobes posterior to the pericardium. Such a structure was not observed in the other Qld lithophagines.

Taken together these shell and anatomical characters suggest that *teres* and *antillarum* are not congeneric with *lessepsiana*, *malaccana*, *hanleyana*, *obesa*, *nasuta*, *lima* and *divaricalx*. If this is the case the generic name *Lithophaga* should be restricted to *L. lithophaga*, *L. nigra*, *L. teres* and *L. antillarum*. The other seven Qld species, presently assigned to various subgenera, deserve generic separation from *Lithophaga*. In my own opinion there is insufficient difference between these seven species to warrant even subgeneric distinction among them.

If these views should prevail then the oldest of the current subgeneric names, i.e. *Leiosolenus* Carpenter, 1856, should be elevated to generic status and the other pertinent subgeneric names, i.e. *Diberus*, *Myoforceps*, *Labis* and *Myapalmula*, should fall into synonymy. However, the type species of most of these subgenera are American and until their anatomy has been examined in comparison with the Qld series it would be unwise to take this action.

SUMMARY

The habitats and shell and anatomical morphology of 9 Queensland species of the rock-boring mytilid genus *Lithophaga* are described, and their nomenclature and geographical distribution are reviewed.

All 9 species are shown to be widely distributed. In Queensland and Central Indo-West Pacific localities at least 6 of these species will be found living together wherever there is abundant coral and calcareous rocks although they show some degree of

habitat preference. The majority of the species will burrow only in dead coral or calcareous rocks. *Lithophaga lima* and *L. lessepsiana* burrow in living corals but each is restricted to a limited variety of coral host species.

The morphological data indicate that the generic and subgeneric classification of these mytilids needs revision.

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KEY TO FIGURE CAPTIONS

a. add.	anterior adductor
a. art.	anterior artery
ac. gl.	"acid gland"
a. gen. d.	anterior genital duct
an.	anus
a. retr.	anterior retractor
au.	auricle
br. sept.	branchial septum
bys	byssus
ct.	ctenidium
cil. tr.	ciliated rejection tract
ct. asc. lam.	ascending lamella of right ctenidium (inner demibranch)
ct. desc. lam.	descending lamella of right ctenidium (inner demibranch)
ct. i. d.	inner demibranch of ctenidium
ct. o. d.	outer demibranch of ctenidium
dig. gl.	digestive gland
ex. siph.	excurrent siphon
f. per.	floor of pericardium
ft.	foot
g.	gonad
gill ax.	gill axis (left)
inc. siph.	incurrent siphon
inn. m. lobe fused	inner mantle lobe fused
int.	intestine
k.	kidney
lab. p.	labial palp
lig.	ligament
m. c. cul de sac	dorsal cul de sac of mantle cavity
mes.	mesosoma
p. gen. d.	posterior genital duct
pl. can.	plicate canals
o.m.l.	outer lobe of mantle
pap.	papillae
per.	pericardium
p. add.	posterior adductor
p. retr.	posterior retractor
rect.	rectum
ren. gen. pap.	renal and genital papillae
s. br. pock.	supra-branchial pockets
sh.	shell
siph. retr.	siphonal retractor
t. b.	transverse bars in roof of supra-branchial chamber visible in floor of pericardium
v.	ventricle
v. cup. br. sept.	ventral cup of branchial septum
v. p. br. sept.	ventral partition of branchial septum.

FOOTNOTE

Since this manuscript was initially submitted a study by Dr Karl Kleeman (Oct., 1977, *Veliger*, 20 (2): 151-154, figs 1-8) has been published in which a description of a new species, *L. kuehnelti*, is given. The host coral was *Acropora palifera* and the type locality is Heron I., Queensland.

The diagnostic character of *L. kuehnelti* is said to be the presence of posterior incrustations on the shell. According to Kleeman this feature is lacking in *L. lessepsiana*, which he reports as occurring in the same host corals at Heron I. as his new species. Kleeman also regards *L. simplex* as a distinct species and gives a redescription of it claiming that *L. simplex* also lacks "real incrustation".

Since the appearance of this paper I have re-examined my own Queensland material which includes large series topotypic of both *L. simplex* and *L. kuehnelti*. I cannot confirm Kleeman's conclusions regarding the nature and significance of variation in the posterior incrustations of these mussels. In my manuscript I have noted that the nature of posterior incrustations in this group vary with the species of host coral. In my opinion this is a very poor character to use for species differentiation in *Lithophaga*. I can find no anatomical or colour differences which might support the opinion that more than one species exists.

Thus, what I have interpreted here as ecotypes, Kleeman regards as species. The question needs further study but on available evidence I propose to include *L. kuehnelti* with *L. simplex* in the synonymy of *L. lessepsiana*.

1. *Lithophaga teres* (Philippi) Low Isles, Qld. AM. regn. no. C63285.

HOLOTYPE of *L. t. annectans*, Iredale.

- (a) Left valve (x1).
- (b) Dorsal (x 1).
- (c) Enlargement of a section of the ventral surface showing vertical cords aligned in growth series.

2. *Lithophaga teres* (Philippi). Aden, "Dr Jousseume, 1917". From M.N.H.N. collection, Paris. SYNTYPES of *L. erythraensis* Lamy.

- (a) Left valve (x 0.75).
- (b) Right valve, internal (x 0.75).
- (c) Dorsal (x 0.75).

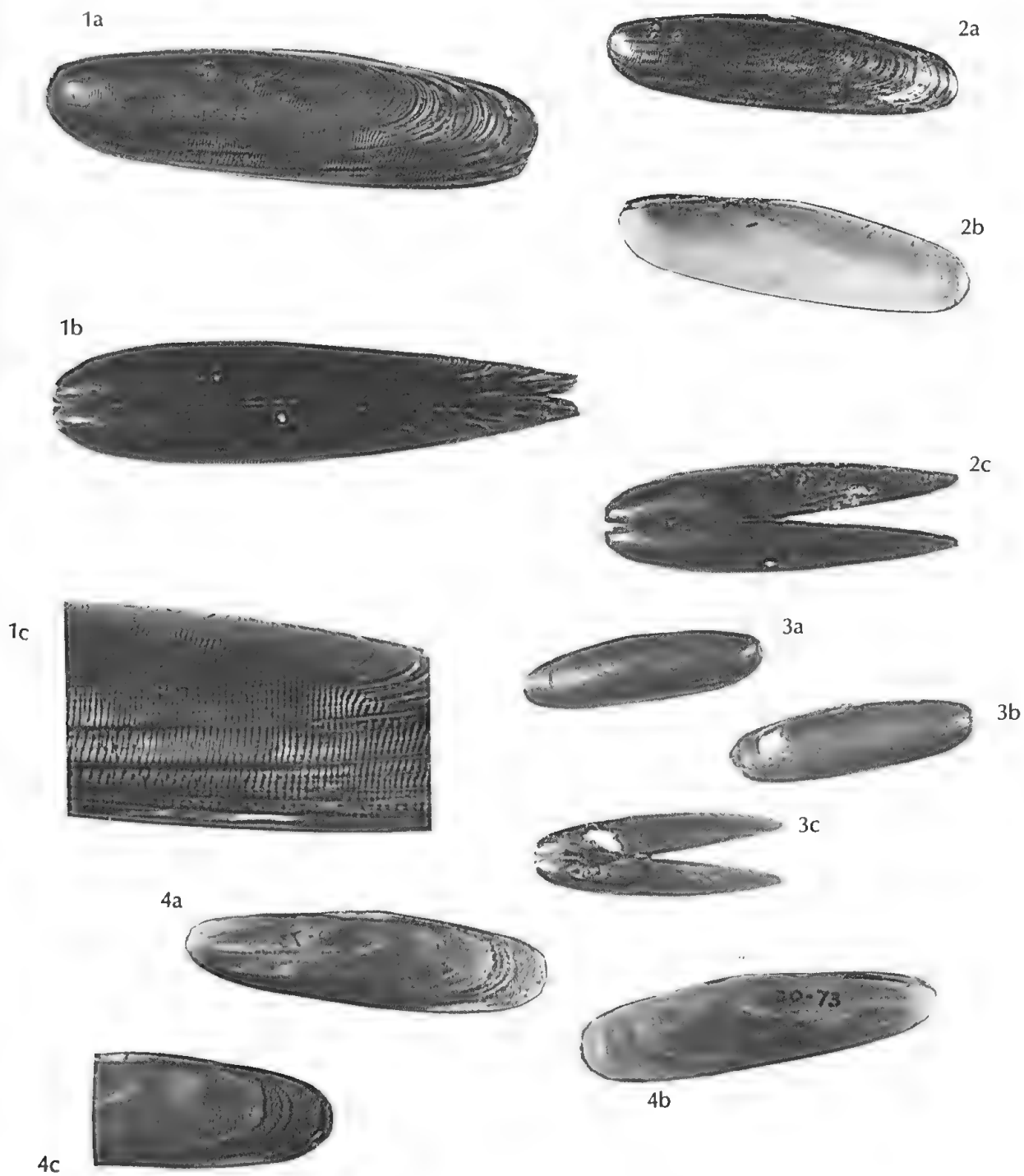
3. *Lithophaga teres* (Philippi). Djibouti, "Dr Jousseume, 1917". From M.N.H.N. collection, Paris. SYNTYPES of *L. erythraensis* Lamy.

- (a) Right valve (x 0.75).
- (b) Right valve second specimen (x 0.75).
- (c) Dorsal (x 0.75).

4. *Lithophaga antillarum* (d'Orbigny). S.E. side Heron I., Qld. WAM regn. no. 30-73.

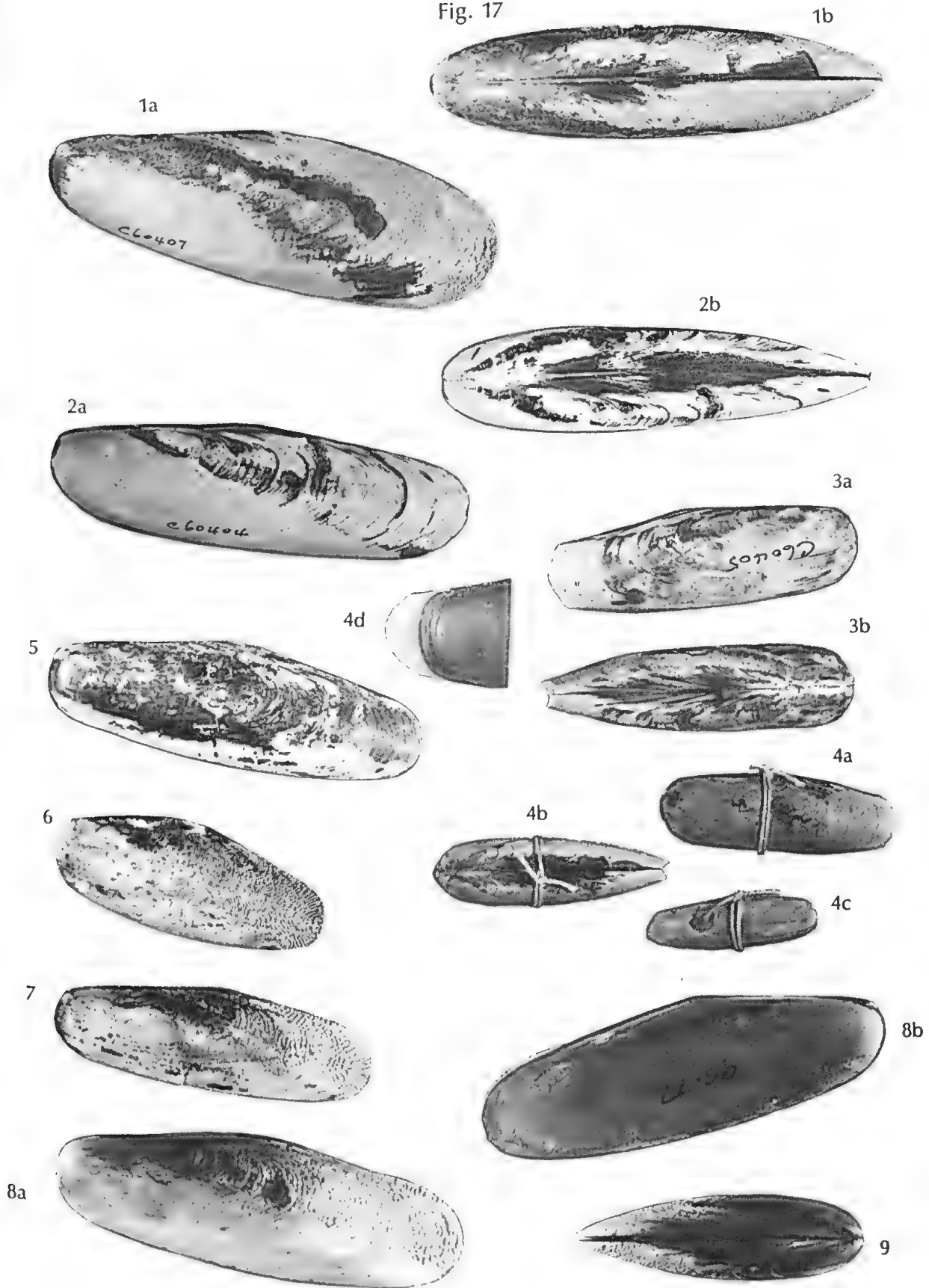
- (a) Left valve (x 1).
- (b) Left valve, internal (x 1).
- (c) Enlargement of posterior end showing chevron-like sculpture.

Fig. 16



1. *Lithophaga obesa* (Philippi). Low Isles, Qld. AM. regn. no. C60407.
HOLOTYPE of *L. obesa suspecta* Iredale.
 (a) Left valve (x 0.75).
 (b) Dorsal (x 0.75).
2. *Lithophaga nasuta* (Philippi). Low Isles, Qld. AM. regn. no. C60404.
HOLOTYPE of *L. dichroa* Iredale.
 (a) Right valve (x 1).
 (b) Dorsal (x 1).
3. *Lithophaga hanleyana* (Reeve). Low Isles, Qld. AM. regn. no. C60405.
HOLOTYPE of *L. laevigata instigans* Iredale.
 (a) Right valve (x 1).
 (b) Dorsal (x 1).
4. *Lithophaga hanleyana* (Reeve). Suez. B.M. (N.H.). collection. SYNTYPES.
 (a) & (b). Largest unbroken syntype (x 1).
 (c) Smallest syntype (x 1).
 (d) Enlargement of posterior end, third (broken) syntype, showing chisel-like extension of incrustation.
5. *Lithophaga lima* (Lamy). Djibouti. From M.N.H.N. collection, Paris. SYNTYPE.
 Left valve (x 0.75).
6. *Lithophaga lima* (Lamy). Aden. "Dr Jousseume, 1917". From M.N.H.N. collection, Paris. SYNTYPE.
 Left valve (x 1).
7. *Lithophaga lima* (Lamy). Aden "Dr Jousseume, 1917". From M.N.H.N. collection, Paris. SYNTYPE.
 Left valve (x 1).
8. *Lithophaga Lima* (Lamy). North Point, Lizard Island, Qld. WAM. regn. no. 95-77.
 (a) Left valve (x 1).
 (b) Left valve interior (x 1).
9. *Lithophaga lima* (Lamy). Rocky Point, Lizard Island, Qld. WAM. regn. no. 96-77.
 Dorsal (x 1).

Fig. 17



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AND MIKE W. GILLAM

PSILOPSOCIDAE AND MYOPSOCIDAE (INSECTA: PSOCOPTERA)
OF THE BISMARCK ARCHIPELAGO, SOLOMON ISLANDS
AND NEW HEBRIDES

C. N. SMITHERS AND I. W. B. THORNTON

A TAXONOMIC REVISION OF THE GENUS *MENETIA* (LACERTILIA, SCINCIDAE) IN THE NORTHERN TERRITORY

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ABSTRACT

The genus *Menetia* in the Northern Territory comprises three species: *M. alanae* sp. nov., *M. greyii* (Gray), and *M. maini* Storr. *M. zynja* Ingram, first described from Queensland is synonymized with *M. maini* Storr.

INTRODUCTION

Recently, the genus *Menetia* has come under scrutiny (Storr, 1976; Ingram, 1977) with the result that a previously monotypic genus now has five species allotted to it. The above studies dealt only with *Menetia* from Western Australia and Queensland. The present study examines *Menetia* from the Northern Territory in which there are representatives from both Western Australia and Queensland.

Storr (1976) provided a definition of the genus *Menetia* which was later amended by Ingram (1977), and all species considered here are within the genus as defined by Storr (1976). The term presuboculars is used in the present paper to refer to the scale or scales located in a diagonal line between the posterior loreal and the subocular labial (Fig. 1). Allometric changes in *Menetia* head shape are great, and in juveniles a presubocular scale may be confused with a loreal scale, giving the impression that three loreals are present, when in fact all *Menetia* have only two loreal scales on each side. The enlarged circumocular granule referred to by Storr (1976) and Ingram (1977) is also shown in Figure 1. (Although *Menetia surda* is not found in the Northern Territory, it is figured because it demonstrates well the variation in head shield configuration expressed in the genus.)

The specimens used in this study are lodged in the Australian Museum (AM); the Australian National Wildlife Collection (ANWC); the National Museum of Victoria (NMV); the collection held at the Arid Zone Research Institute, Alice Springs (NTM — A/S); the Northern Territory Museum, Darwin (NTM); the South Australian Museum (SAM); the Western Australian Museum (WAM); and Mr Harry Ehmann's personal collection, which will be lodged in the SAM (HFWE).

TAXONOMY.

Key to the species in the genus *Menetia* occurring in the Northern Territory.

1. (a) Second supraciliary much larger than first, contacting prefrontal, thus precluding contact between first supraciliary and first supraocular 2

*Deceased, 2nd January, 1979.

- (b) Second supraciliary a little larger than first, not contacting prefrontal, thereby permitting contact between first supraciliary and first supraocular *mainii*
2. (a) Two presuboculars on each side, tail length 123-134% of SVL; pale midlateral stripe invariably absent *alanae*
- (b) One presubocular on each side, tail length 145-178% of SVL; pale midlateral stripe present, at least anteriorly *greyii*

***Menetia alanae* sp. nov.**

Figs. 1-3

HOLOTYPE: R52064 in the Australian Museum, Sydney. Collected by P. R. Rankin on 25 September 1975 on the alluvial plain immediately southeast of Mt. Carr, Adelaide River Township, Northern Territory, 13°15'S, 131°06'E.

PARATYPES (10): Tapa Bay, Cox Peninsula, N.T., 12°27'S, 130°36'E (ANWC R748); Berrimah, Darwin, N.T., 12°25'S, 130°55'E (AM R41503, ANWC R779-782); Nakara, Darwin, N.T. (NTM R4733); 32.5 km SE of Noonamah, N.T., 12°54'S, 131°12'E (NTM R2739); 45 mi. S. Darwin, N.T., 12°53'S, 131°07'E (WAM R37134); Adelaide River Township, N.T. 13°15'S, 131°06'E (AM R52065).

DIAGNOSIS: Second supraciliary contacts prefrontal; two presuboculars on each side. Most similar to *M. greyii* from which it is readily distinguished by total lack of pale midlateral stripe and much shorter tail (123-134% of SVL versus 145-178% of SVL).

DESCRIPTION OF HOLOTYPE: Snout-vent length: 29.0 mm; tail length (regenerated): 20.0 mm; axilla-groin length: 17.5 mm (60% of SVL); snout sharp; body form rounded, not depressed; ear opening distinct.

Nasals moderately separated; prefrontals in broad contact; supraciliaries 3/3, second contacting prefrontal; first supraocular slightly more than twice as long as wide; presuboculars 2/2; supralabials 6/6, the fourth in a subocular position on each side; upper circumocular granule no larger than other circumocular granules; interparietal not fused to frontoparietal; midbody scale rows 22; subdigital lamellae under fourth toe 19/19, smooth with broad pale calli.

Colour and pattern (in alcohol): Dorsally pale brown with a few darker flecks aligned longitudinally in two rows along the paravertebral scales, most prominent posteriorly. Upper lateral zone dark greyish brown, poorly defined from the dorsum, merging to grey on the lower lateral zone. No pale midlateral stripe. Upper labials white, speckled with brown. Limbs pale brown with sparse darker flecks above. Venter immaculate white except for underside of tail which is pale yellow.

VARIATION: Meristics and measurements of the paratypes are included in Table 1. In all but one paratype, the nasals are moderately separated — in WAM R37134, they are only narrowly separated. Among the paratypes, the prefrontals are in broad to moderate contact and in other respects the head shield configuration is as for the holotype.

Colour and pattern (in alcohol): In adults the colour and pattern is as for the holotype, but in juveniles, the upper lateral zone is black, sharply defined dorsolaterally from the pale cream or brown coloured dorsum. In juveniles (as with the adults) there is no pale midlateral stripe, and in life, the venter is pale grey and the tail grey-brown.

A juvenile specimen (NTM R2828) from 32 km NE of Oenpelli, N.T., is tentatively placed with *M. alanae* pending examination of adults from this population. In most respects, the specimen conforms to this species, but it differs from the type series in that the prefrontals are not in contact and in life it had a bright blue tail (Mr Brian Jukes, pers. comm.).

DISTRIBUTION: *M. alanae* occurs in the humid coastal and near coastal regions of the northwestern Northern Territory (Fig. 3).

HABITAT: The author's specimens of *M. alanae* from Adelaide River were collected in September 1975 in thick leaf litter beneath trees on the sandy alluvial river flat. The lizards were noted to be particularly active during late afternoon. The data with the series collected by Mr John Wombey at Berrimah in February to March 1972 state that they were "out in wet leaf litter". The Tapa Bay specimen, also collected by Mr Wombey, was stated to be in "sandy open coastal mixed forest".

It may be of interest to note that *M. alanae* shares the same habitat at *Ctenotus storri* (Rankin 1978), and the two species were taken in conjunction both by the author and Mr Wombey at all of the localities listed for *M. alanae* in the previous paragraph.

ETYMOLOGY: The species is named after Ms Alana Young of the Department of Herpetology, Australian Museum, in appreciation of assistance she has given the author in previous projects, particularly with the typing of manuscripts.

Menetia greyii

Figs. 1-3

Menetia greyii Gray 1854 "Catalogue of the Lizards in the Collection of the British Museum" p.66. Type locality: "Western Australia". (See Storr, 1976, for designation of lectotype.)

DIAGNOSIS: Second supraciliary contacts prefrontal; one presubocular on each side. Pale midlateral stripe distinct, at least anteriorly; lower lateral zone consists of several thin dark stripes.

DESCRIPTION AND VARIATION: Meristics and measurements are included in Table 1. Snout short; body depressed; ear opening distinct; nasals moderately to widely separated; prefrontals usually separated, rarely in point contact; supraciliaries 3, second contacting prefrontal; first supraocular more than twice as long as wide; presuboculars almost invariably 1/1; supralabials 6, fourth in a subocular position; nuchals 1/1; upper circumocular granule no larger than other circumocular granules; interparietal generally distinct from frontoparietal; subdigital lamellae broadly callose to slightly compressed.

Colour and pattern (in alcohol): Dorsum pale brown to grey with longitudinally aligned series of 2-4 dark brown or black spots on the mid-dorsal scales. Upper lateral zone darker than, and distinctly demarcated from dorsum, sometimes with a narrow, pale, indistinct dorsolateral stripe, especially anteriorly. A white midlateral stripe invariably present, but varying in intensity from almost indiscernible to distinct; always most distinct anteriorly. Lower lateral zone consists of several very narrow, irregular, black longitudinal stripes, especially posteriorly. Venter immaculate white, except for underside of tail which is flecked with darker spots.

A specimen (NTM R2885) from Cahills Crossing, East Alligator River (lat. 12°26'S, long. 132°58'E) is tentatively placed with this species, although it possibly represents an

unnamed taxon. It differs from typical *M. greyii* in having two presuboculars on each side, and a markedly different colour pattern. It has a very broad black upper lateral zone with a conspicuous white midlateral stripe, and the dorsum is pale cream. In addition, its body is more slender than in typical *M. greyii*, and it has only 20 midbody scale rows. Although the Groote Eylandt *M. greyii* (NTM — A/S 5320) has 20 midbody scale rows, the nearest mainland specimen having 20 is from Mt. Doreen Station (22°S). The nearest typical *M. greyii* to Cahills Crossing is from Muriella Park ruins (ANWC R408), only 60 km to the southwest.

Storr (1976) commented that midbody scale counts of 20 were as common as 22 for *M. greyii* in the Northern Territory. Of the 94 specimens examined in this study, only 8 (8.5%) had 20, the remainder 22.

DISTRIBUTION: *M. greyii* occurs continuously throughout the Northern Territory at least as far north as the Barkly Tableland. A population occurs on Groote Eylandt, and there is a specimen from the drainage of the Alligator Rivers (Fig. 3). The species is distributed extraliminally in W.A., S.A., Vic., N.S.W., and Qld. (see Cogger, 1975).

HABITAT: *M. greyii* inhabits flat to undulating country on a wide variety of soil types, from sandy to hard gibber plains and black soil downs, usually with a fairly stunted, open vegetation. In the author's experience, it is not found on rocky hillsides or in heavily wooded areas. Whether or not the species is as continuously distributed in the northernmost parts of its range as it is in the south remains to be determined. Dr G. Storr (in litt.) has commented that *Menetia* is replaced ecologically by *Proablepharus* in the Kimberley region of W.A. As well as this, at least two other species of *Menetia* already occur in the far northern parts of the Northern Territory, and these may largely exclude *M. greyii* from the region.

MATERIAL EXAMINED: During the course of this study, the entire series of *Menetia* in the Australian Museum was examined, but only localities in the Northern Territory are presented here.

ANWC (2): Muriella Park (ruins), 12°50'S, 132°44'E (R407); E of Old Andado Station (R747).

AM (19): 5 km N of Alice Springs (R12018); Frewena (R17420); 50 km W of Haast's Bluff (R21107); 30 km WNW of Mt. Olga (R26402); vicinity of Finke (R26504); near Andado Station (R26548-9); Simpson Desert, 25°35'S, 135°50'E (R26561); Simpson Desert, 25°30'S, 137°04'E (R26574); Alice Springs (R49285-6, R52061); 45 km from Andado on Charlotte Waters track (R49506); 6 km N of Alice Springs (R49539); Stuart Hwy, 72 km SW of Alice Springs (R52060); Roe Creek (R52062-3); Simpson Desert, 24°07'S, 135°20'E (R53172); ridge near Casey Bore (R53171); 24 km S of Anthony Lagoon (R60112).

NMV (5): Mt. Doreen Station (DT-D 0230); Glen Helen Camp (D2283); Palm Creek (D3320); Sanders Creek (D5583); Ayers Rock (D8045).

NTM (20): Alice Springs (R766); Napperby Creek crossing (R1389); Maryvale (R1602-3, R1647, R1874-9, R1886-7, R1982); Armstrong Creek, ca 100 km W of Ayers Rock (R1670, R1693-4); Curtin Springs (R1684); Mt. Gillen, Alice Springs (R1937); Brunette Downs Racecourse (R3648).

NTM — A/S (22): Standley Chasm (1053); Ooraminna (1543-4); Phillipson Stock Route, 24°25'S, 133°35'E (1545); Alice Springs (1563, 1565, 1567-73, 2855, 2897-8); Groote Eylandt (5320); Epenarra, 20°25'S, 135°18'E (5372); Thompsons Rock-hole, Tanami Sanctuary, 20°38'S, 130°59'E (5382); Connells Reserve, 18°48'S, 136°30'E (5384-5); 22 mi E of Ayers Rock (5514).

SAM (9): Tennant Creek (R5863, R5866); 2 km W of Yuendumu (R10319); 1 km E of Emily Gap (R11286); Alice Springs (R11289-92); Finke River (R13317).

HFWE (25): Charlotte Waters (0300-10); 14 km E of Charlotte Waters on New Crown Road (0312-3, 0358); 39 km N of Charlotte Waters (0328); North Alice Springs (0391-2); 78 km S of Alice Springs on Old South Road (0396); Brunette Downs Creek crossing on Borroloola road (0611-7).

Menetia maini

Figs. 1-3

Menetia maini Storr (1976) Rec. West. Aust. Mus., 1976, 4(2), p. 198. Type locality: 23 km SSE of Derby, W.A., 17°29'S, 123°43'E.

Menetia zynja Ingram (1977) Vict. Nat. 94, p. 186. Type locality: Mt. Unbunmaroo, 90 km NW of Boulia, Qld., 22°32'S, 140°18'E.

DIAGNOSIS: Second supraciliary does not contact prefrontal; presuboculars one or two. Pale midlateral stripe absent.

DESCRIPTION AND VARIATION: Meristics and measurements are included in Table 1. Snout short; body rounded but not depressed; ear opening distinct; nasals moderately to widely separated; prefrontals varying from moderate contact to narrowly separated; supraciliaries 3, second not contacting prefrontal; supraocular more than twice as long as wide; interparietal free from frontoparietal; nuchals 1/1; upper circumocular granule no larger than other circumocular scales; presuboculars 1 or 2 on each side; supralabials 6/6, fourth in a subocular position; subdigital lamellae smooth with broad, dark calli.

Colour and pattern (in alcohol): Dorsally dark greyish brown, liberally flecked with minute black spots especially on head. Lateral zone dark greyish brown (darker than dorsum), sometimes with a narrow pale indistinct dorsolateral stripe anteriorly. Sides of head (including upper and lower labials), grey, liberally flecked with darker spots. Tail brown above, with a few darker spots, often with a fairly well defined pale stripe separating dark grey lateral zone from dorsum. Limbs dark brown with distinct paler mottlings. Venter grey, darker beneath tail. Occasionally, a very short indistinct white midlateral stripe anteriorly.

The variability in the presubocular scales in this species is clearly shown by two specimens from south of the Gulf of Carpentaria. In AM R53307 from Caranbirini Waterhole in the McArthur River drainage there is one presubocular on one side, and two on the other. In the other specimen (HFWE 0569), from 249 km E of the Stuart Hwy, on the Carpentaria Hwy (close to the last locality), there is one presubocular on one side and an incompletely divided one on the other.

The number of midbody scale rows tends to be lower in specimens from the east than in those from the western part of the species' total known range; however, no evidence suggests a smooth clinal distribution in this character. In the Northern Territory, the distribution of midbody scale rows does not conform to any geographic pattern, and does not correlate with the number of presuboculars.

DISTRIBUTION: In the Northern Territory, *M. maini* is distributed mainly across the northern parts, south to Daly Waters and the McArthur River drainage, with probable isolated populations at Peko and Mt. Doreen. It also occurs on Centre Island in the Sir Edward Pellew Group (Fig. 3). The species is distributed extralimittally in the Kimberley region of W.A. (Storr, 1976) and in Queensland as far east as Normanton (AM R63421-3).

HABITAT: Most of the specimens for which the author has been able to ascertain habitat were from hard stony soils in hilly or undulating country. Mr Richard Wells (pers. comm.) reports that the specimens from Pine Creek were taken in leaf litter in tropical woodland on stony lateritic soil in undulating country.

COMMENTS: Considering the material available, there is no evidence to justify the maintenance of *M. zynja* as a taxon separate from *M. maini*. Ingram (1977) gave the number of supraciliaries and the number of presuboculars as the characters separating *M. zynja* from *M. maini*. However, all *M. maini*, including the type of *M. zynja* have 3 supraciliaries. The variability in the number of presuboculars in this species has been demonstrated above.

As almost all of the Northern Territory specimens of *M. maini* are single individuals from a given locality, the extent of local variability within the taxon cannot be determined at present.

MATERIAL EXAMINED: AM (5): Centre Island, Sir Edward Pellew Group (R57355); Caranbirini Waterhole, ca 21 km N of McArthur River Crossing, 16°16'S, 136°05'E (R53307); Bessie Spring, McArthur River Station, 16°40'S, 135°51'E (R55372); Glyde River, 10 km E of McArthur River Mining Camp (R53647); Mt. Doreen (R49546).

NTM (3): Ban Ban Spring, 13°22'S, 131°30'E (R3181); 5.5 km N of Pine Ck., 13°50'S, 131°48'E (R3100-1).

HFWE (3): 2 km S of Daly Waters (0455); 32 km S of Katherine (0526); 249 km E of Stuart Hwy on Carpentaria Hwy (0569).

WAM (1): Peko (R21474).

ACKNOWLEDGEMENTS

I would like to express my appreciation to the following people who provided information on the habitats of specimens of *Menetia* which they collected in the Northern Territory: H. G. Cogger, H. F. Ehmann, M. W. Gillam, A. E. Greer, G. Husband, B. Jukes, D. C. Metcalfe, G. M. Storr, P. N. Webber, R. W. Wells, J. C. Wombey. Thanks must also go to the following people and committee who allowed me to examine material in their care: H. G. Cogger, J. A. Coventry, M. W. Gillam, G. F. Gow, A. E. Greer, T. F. Houston, G. J. Ingram, G. M. Storr and the Donald Thompson Collection administration committee. Finally, the following people assisted greatly by reading and providing criticisms of the manuscript in its varying stages: H. G. Cogger, A. E. Greer, G. M. Storr, G. J. Webb.

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Table 1

Meristics and measurements of Northern Territory *Menetia* species. Ranges are given on the top line, means below in brackets.

	Midbody Scale Rows	Subdigital Lamellae (4th toe)	SVL	Tail Length (% of SVL)	Axilla- Groin (% of SVL)
<i>M. alanae</i> N=10	22-24 (22.2)	17-20 (18.5)	14.5-29.0 (23.0)	(N=4) 123-134 (130)	48-60 (53.1)
<i>M. greyii</i> N=77	20-22 (21.7)	17-24 (20.7)	12.5-36.0 (29.7)	(N=11) 145-178 (161.6)	48-63 (57.1)
<i>M. maini</i> N=12	18-26 (21.6)	18-20 (18.9)	15-28 (24.5)	(N=3) 118-128 (122.6)	50-63 (56.6)

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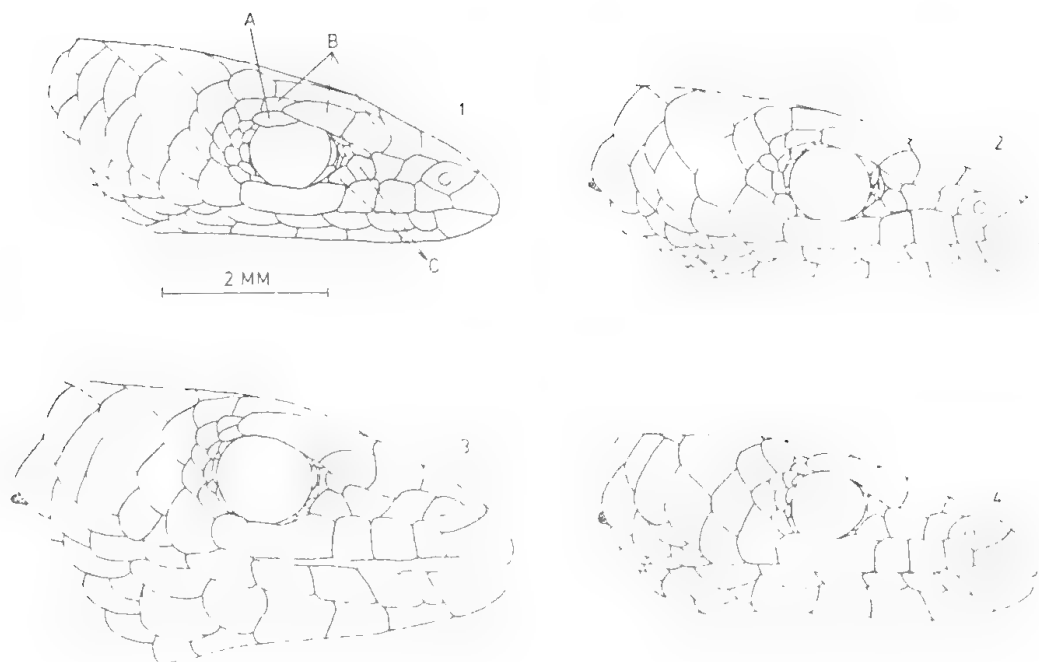
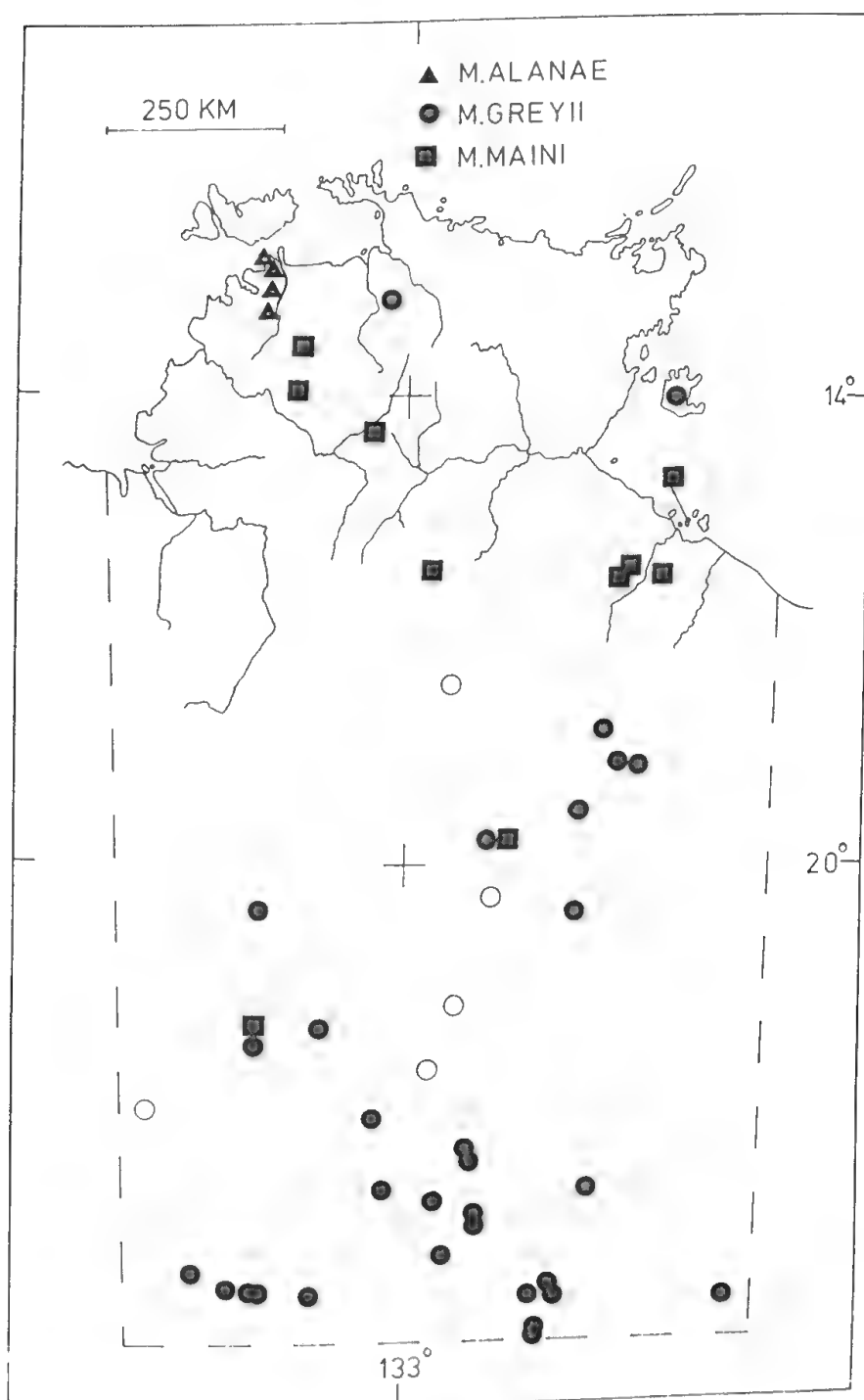


Fig. 1. Lateral aspects of the heads of *Menetia* species. (1) *M. surda*, a Western Australia species (WAM R 54573). A: Enlarged upper circumocular granule, B: Supraciliary scales, C: Presubocular scales; (2) *M. alanae* holotype (AM R 52064); (3) *M. greyii* (AM R 53171); (4) *M. maini* (NTM R 3100).



Fig. 2. Dorsal aspect of the heads of Northern Territory *Menetia* species. (1) *M. alanae* holotype (AM R 52064); (2) *M. greyii* (AM R 53171); (3) *M. maini* (NTM R 3100).



Figs. 3. Map showing locality records for *Menetia* species in the Northern Territory. Open symbols are literature records from Storr (1976). Records for specimens only tentatively allocated to species are not included. Some symbols represent more than one locality.

A NEW LIZARD IN THE GENUS *CTENOTUS* (LACERTILIA: SCINCIDAE) FROM THE NORTHERN TERRITORY WITH NOTES ON ITS BIOLOGY

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ABSTRACT

A new species in the genus *Ctenotus*, from the Northern Territory is described and figured. It has previously been confused with *C. inornatus* from which it is distinguished. Data are provided on its reproduction and habitat preferences. Aspects of reproduction of *C. inornatus* are considered in a comparison between the two species.

INTRODUCTION

Storr (1970) reviewed the members of the genus *Ctenotus* occurring in the Northern Territory, recognising twenty-three species, but subsequently (1971) removed one species (*C. taeniatus*) from this list, basing his action on a misidentification. It has since been added to twice with the description of *C. storri* (Rankin 1978) and the discovery of *C. regius* by Gillam *et al.* (1978).

The species groups of *Ctenotus* introduced by Storr are not employed here, as the status of these groups is obscure (see Storr 1969, p.98) and the species described below is considered distinctive enough to facilitate diagnosis without such measures.

The following abbreviations are used throughout this paper. AM: Australian Museum, Sydney; ANWC: Australian National Wildlife Collection, Canberra; NTM-A/S: the collection held at the Arid Zone Research Institute, Alice Springs.

The new species is distinguished by a prominent black vertebral stripe, hence we propose to call it *Ctenotus vertebralis* sp. nov.

Ctenotus vertebralis sp. nov.

Figs. 1-4

HOLOTYPE: No. R410 in the collection of the Arid Zone Research Institute, Alice Springs, N.T., collected by M. W. Gillam on 5 July 1977, at Arnold River, Cox River Station N.T., 15°43'S, 134°32'E.

PARATYPES: (21) Koongarra, Mt Brockman Range, N.T., 12°53'S, 132°50'E (AM R38842-57); Nourlangie Rock, Mt. Brockman Range, N.T., 12°46'S, 132°39'E (AM R39899); Maranboy Police Station, N.T., 14°32'S, 132°47'E (ANWC R0463, R0474); Cox River headwaters, Cox River Station, N.T., 15°54'S, 134°41'E (AM R65113, NTM-A/S R411).

DIAGNOSIS: *Ctenotus vertebralis* is a moderately small (up to 55 mm SVL), slender species with sparse patterning. It is distinguished from all other described members of the genus by the following suite of characters: a very distinct black vertebral stripe, often pale edged, extending well onto the tail; no distinct pale blotches on upper lateral or

*Deceased

Records of The Australian Museum, 1979, Vol. 32 No. 15, 501-511, Figures 1-6.

outer vertebral zone; no more than 6 narrow pale longitudinal stripes, including pale edges (when present) on black vertebral stripe (often fewer than six when lateral pattern is absent) (Fig. 1.); presuboculars almost invariably 2; supraoculars 4, second largest; supraciliaries subequal in vertical depth; prefrontals rarely in contact; subdigital lamellae moderately compressed, dark; claws on hindlimb sabre-like (see Rankin, 1978).

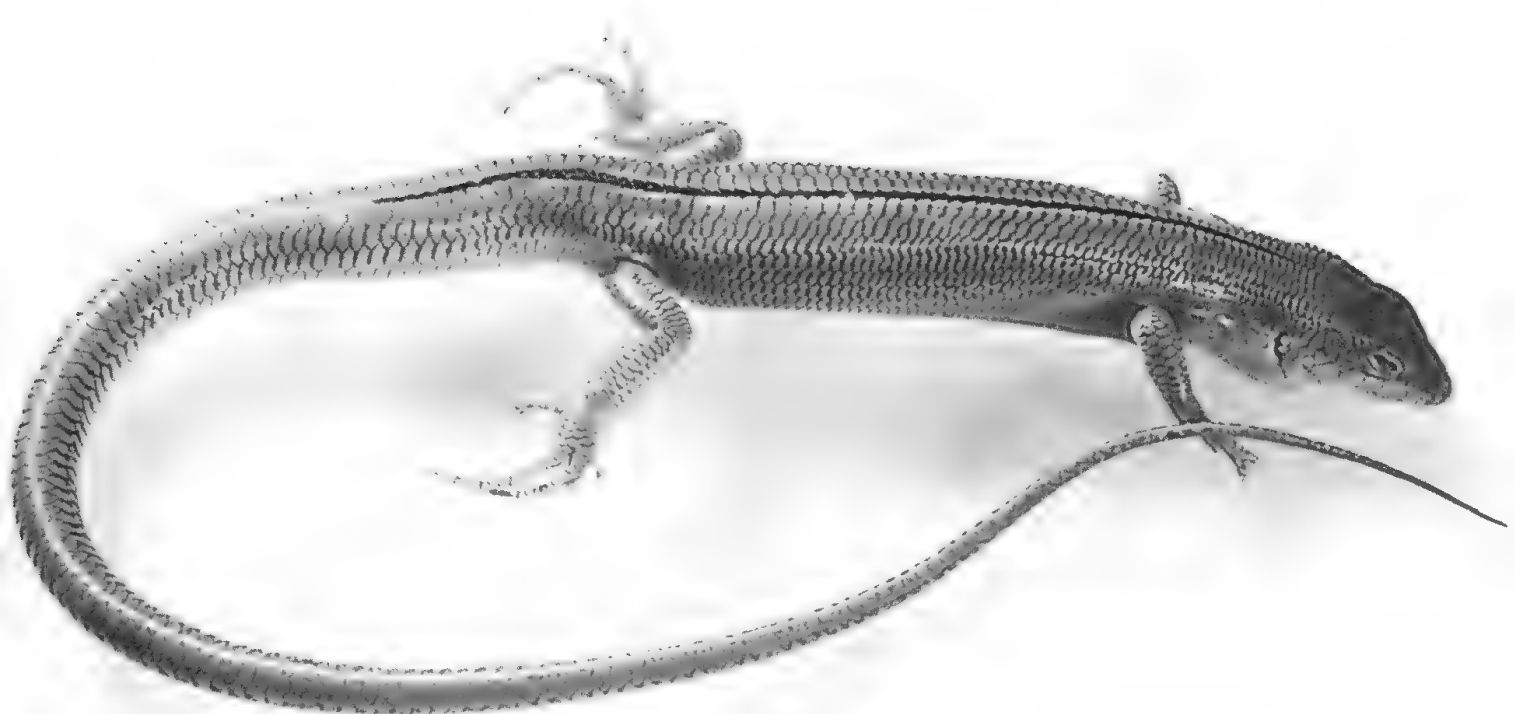


Fig. 1. Photograph of holotype of *Ctenotus vertebralis* (NTM-A/S R410), from Cox River Station, N.T. N.B. This is an extreme variant with respect to colour pattern. See variation in paratypes section and Fig. 3 (Photo G. Millen).

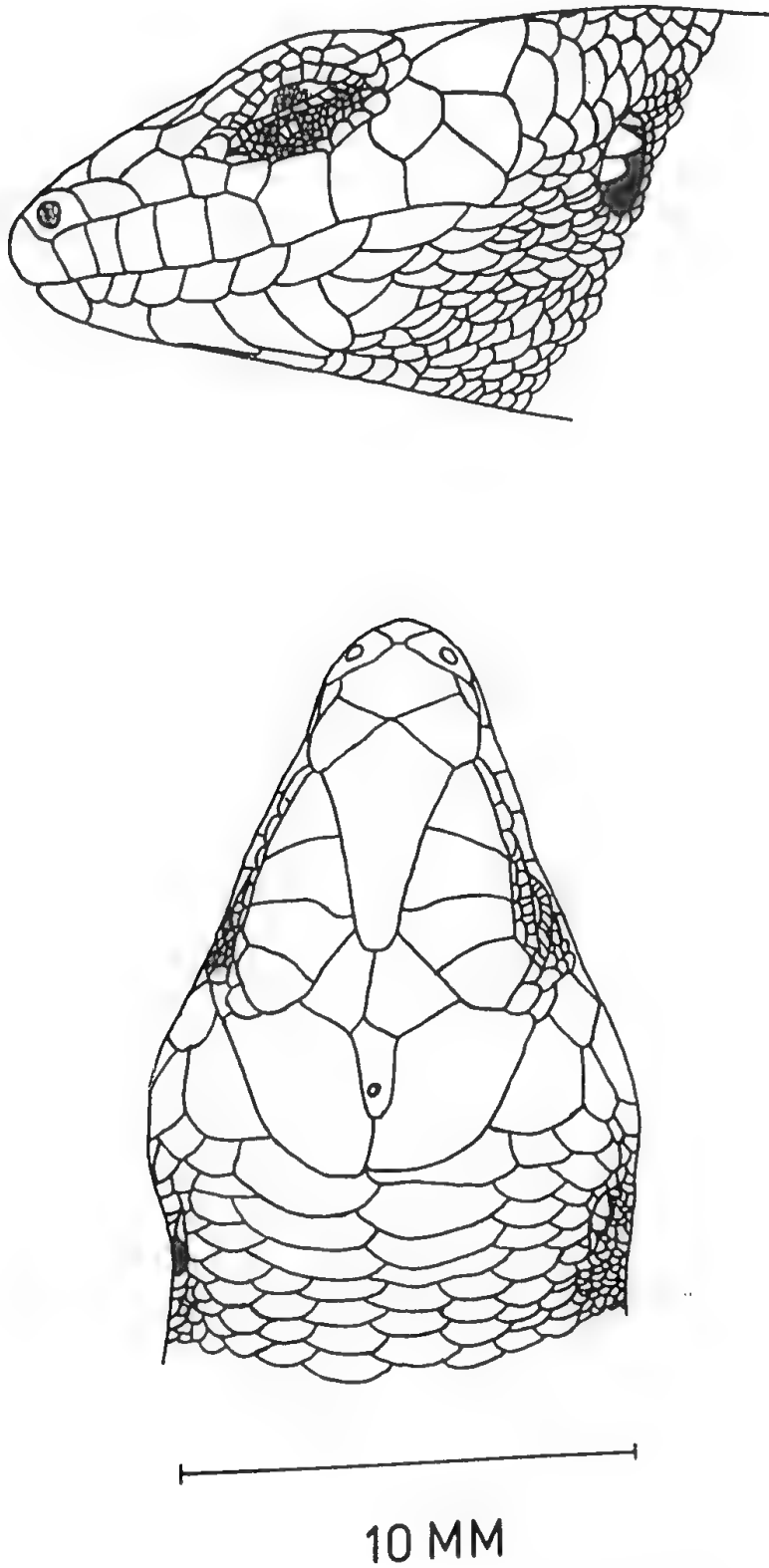


Fig. 2. Head shields of holotype of *Ctenotus vertebralis* (NTM-AVS R410).

DESCRIPTION OF HOLOTYPE: SVL: 55mm; length of tail (original): 137mm (249% of SVL); length of forelimb: 15mm (27% of SVL); length of hindlimb: 25mm (45% of SVL); axilla-groin length: 29mm (53% of SVL); nasals narrowly separated; prefrontals narrowly separated; presuboculars 2/2; supraoculars 4/4, with 3/3 contacting frontal; supraciliaries 7/7; upper palpebrals (palpebrals of Storr) 11/11; supralabials 8/8; infralabials contacting postmental 3/2; ear lobules 3/3, obtuse, uppermost smallest; nuchals 3/4 (Fig. 2.); midbody scale rows 26; paravertebral scale rows, from posterior margin of parietals to posterior margin of hindlimbs, 58; lamellae beneath fourth toe 22/23, each with a dark, slightly compressed callus; claws on hindfeet long and sabre-like.

Colour and pattern (in life): Dorsal surface of body olive-brown, suffused anteriorly with copper. Head and nape contrasting paler olive-grey. A distinct black vertebral stripe (narrower than a paravertebral scale) extends from nape to basal third of tail. Upper lateral zone pale grey-brown. Two rows of very indistinct small cream spots or short dashes, most distinct anteriorly, corresponding in position to dorsolateral and mid-lateral stripes. Temporals streaked with cream. A very indistinct cream subocular streak, dark edged above. Supralabials and infralabials cream, finely peppered with brown. Limbs olive, unmarked. Venter cream.

It should be noted that in colour, the holotype represents one extreme among the known variants.

VARIATION IN PARATYPES: Meristics and measurements are included in Table 1. In all but one of the paratypes, the nasals are narrowly to moderately separated; the exception is AM R39899 in which they are in point contact. All but seven have the prefrontals narrowly to moderately separated and in those where the scales meet, contact is either point or narrow. Ear lobules obtuse to subacute, uppermost not enlarged.

The two paratypes from Cox River Station (NTM-A/S R411, AM R65113) agree very well with the colouring and patterning of the holotype. However, the rest of the type series, from more northerly localities, exhibits a great degree of variation in the intensity of pattern. At one extreme is the pattern described for the holotype. An example of the other extreme is AM R39899 an adult female (SVL=45mm). Its colouring and patterning (in alcohol) is as follows. Head and back dark grey, darker anteriorly. Top of head liberally spotted with black, especially on frontal and frontoparietals. A prominent black vertebral stripe beginning on nape, extending over basal two-thirds of tail, narrowly edged with white on body. A prominent narrow white dorsolateral stripe, extending from behind eye to just past level of hindlimb, for anterior two-thirds of its length margined above distinctly in black. Upper lateral zone from behind ear to level of hindlimb black, enclosing no pale spots or blotches, bordered below by a distinct white midlateral stripe, extending from behind ear to hindlimb, uninterrupted by forelimb. Lower lateral zone dark to pale grey. Sides of head pale brown with very fine dark brown peppering. Limbs pale brown with scattered darker spots. Tail pale brown except for vertebral stripe. Venter pale bluish grey except for underside of appendages which are cream.

The colour pattern just described is found almost universally in the juveniles of the type series which were all collected at Koongarra, but is also retained by several adults. An individual displaying a fairly well developed colour pattern is shown in Fig. 3.

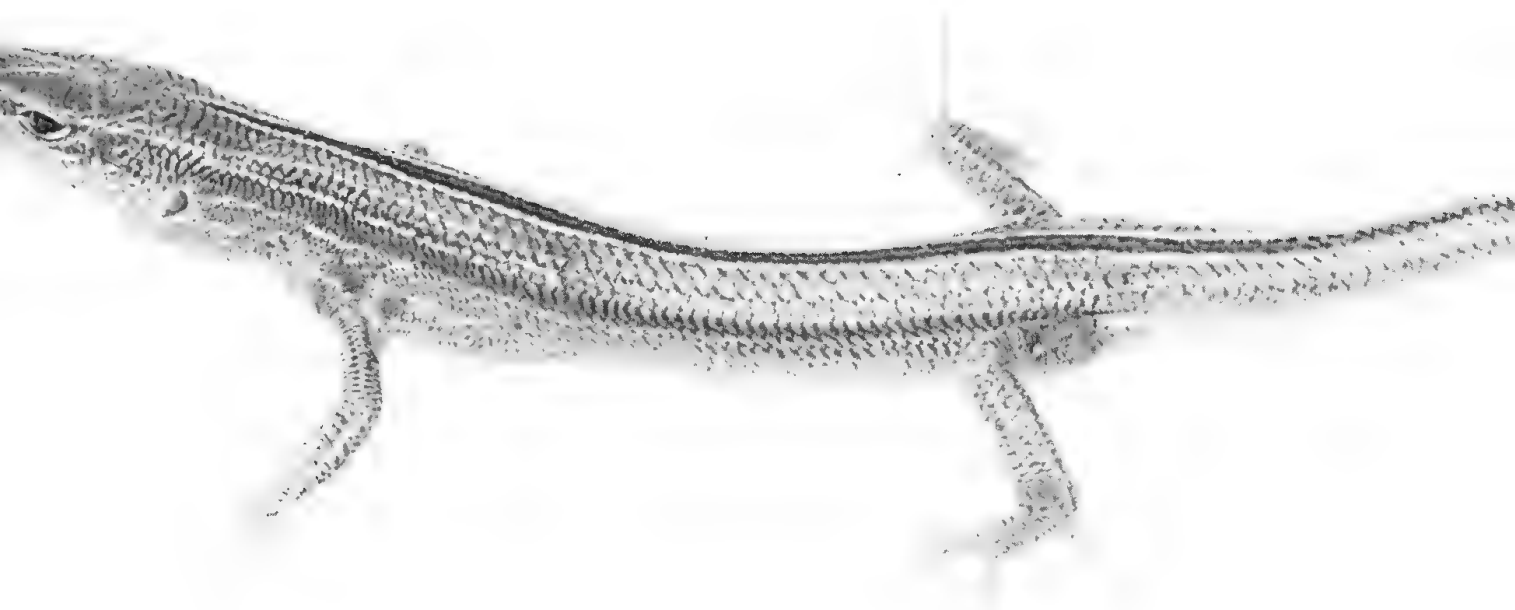


Fig. 3. Photograph of *Ctenotus vertebralis* from Koongarra, Mt. Brockman Range, N.T. This specimen shows a more developed colour pattern than the holotype (Photo H. G. Cogger).

Dr H. Cogger has kindly allowed us to examine his field notes on this species and has permitted us to publish the following colour description in life of an individual (AM R38842, adult female, SVL=50.5mm) from Koongarra which is intermediate in colour between the two extreme individuals described above. "Head silver-grey merging with bright, light bronzy-brown on the neck and back. A conspicuous black vertebral stripe, about one scale wide from nape to base of tail, bordered on either side by a narrow light band. A moderately defined light, white narrow dorsolateral stripe anteriorly, but disappearing about half way along the body, bordered above and below by ill defined narrow dark brown stripes. A relatively conspicuous narrow dark brown upper lateral band, from above the ear to the hindlimb, and bordered below by a vague, narrow white mid-lateral stripe. Below this is a vague brown zone from ear to groin. Venter white. Limbs above light yellowish brown with faint darker brown markings."

DISTRIBUTION: *Ctenotus vertebralis* has been collected in three localities surrounding Arnhem Land in the northern parts of the Northern Territory (Fig. 4).

HABITAT: Gillam observed *Ctenotus vertebralis* on several occasions during the course of a combined wildlife (Department of Northern Territory Public Service) and botanical (Department of Northern Territory) survey of Cox River Station, N.T. (Bolton *et al.*, 1977). Due to thick regeneration growth resulting from a recent fire and the limited time available however, only three individuals were collected.

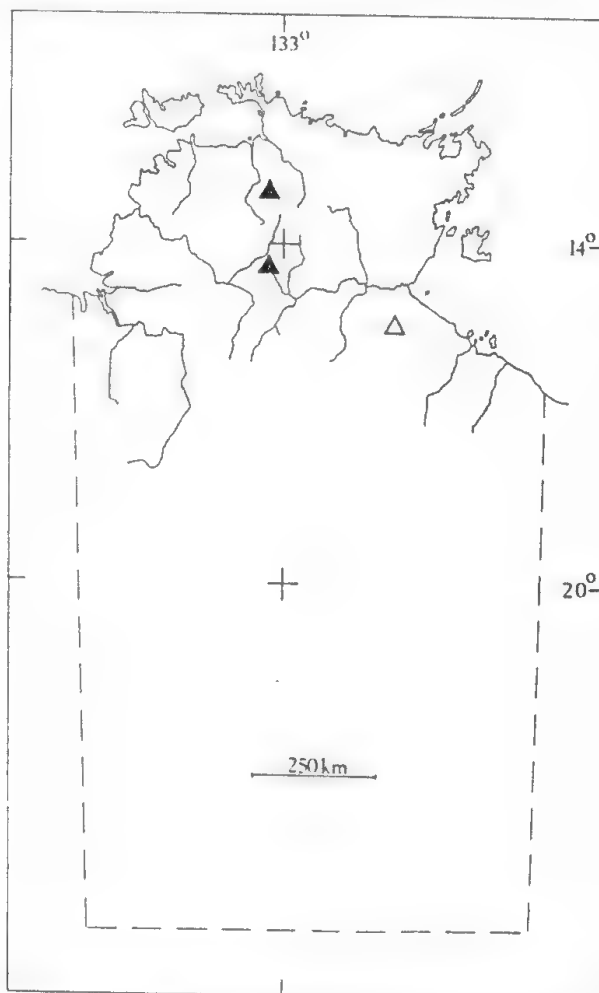


Fig. 4. Map of Northern Territory showing localities where *C. vertebralis* has been collected. The open symbol represents the type locality.



Fig. 5. *Melaleuca leucodendron* woodland at Arnold River, N.T., at the site where the holotype of *Ctenotus vertebralis* was collected.

C. vertebralis was generally observed at Cox River in an ecotonal series of habitats which occurs in the zone between rocky country and the flatter alluvial areas. The specific habitats where the three Cox River specimens were collected may be briefly described as follows. The holotype was taken on an alluvial paperbark (*Melaleuca leucodendron*) woodland (Fig. 5) adjacent to a river and below a rocky rise with Snappy Gum (*Eucalyptus leucophloia*) and Splinfex (*Plectrachne* sp.) covering. The two other specimens (AM R65113, NTM-A/S R411) were taken in woodland areas comprising *Eucalyptus polycarpa* and *Melaleuca* sp. over *Plectrachne* sp. and *Grevillea* sp. These areas were on lateritic to sandy soils, adjacent to broken low lying sandstone ridges. *Ctenotus spaldingi* occurred throughout this habitat with *C. vertebralis* and also extended to the edges of rivers and swamps, a habitat in which *C. vertebralis* apparently did not occur. On the rocky areas, both *C. vertebralis* and *C. spaldingi* were replaced by *C. saxatilis*.

The three *C. vertebralis* from Cox River were collected while active from mid-day to mid-afternoon. When approached and pursued, they appeared reluctant to take refuge in burrows. However, one eventually ran into a disused *Varanus gouldii* burrow, and another ran into a burrow, possibly its own, which was situated beneath a partly buried tree limb in a clearing.

Dr Cogger and Mr J. Wombey recorded habitat data at Mt. Brockman and Maranboy respectively. Their habitat records support those taken on Cox River Station. At Mt. Brockman, *C. vertebralis* was found to be common in the ecotone between rock and flat, open woodland. It was not recorded at all in the rocky areas, and numbers declined in the woodland away from the rock. During the wet season, when most were collected, they attempted to escape into tall annual grasses. At Maranboy, *C. vertebralis* were collected in open woodland where they were uncovered beneath rubbish. The general area is described as undulating stony hills interspersed with flat alluvial areas of Low Woodland with Tussock Grasses (nomenclature for the plant association after Carnahan, 1976).

REPRODUCTION: Like other members of its genus, *C. vertebralis* is oviparous, and a gravid female (AM R39899, SVL=45mm), containing shelled oviducal eggs was taken on 30 July 1973 at Nourlangie Rock, N.T. Unfortunately, due to damage during capture, it is impossible to determine the clutch size accurately, although it appears to be either three or four. Adult females (AM R38842, 38846) collected in February 1973 at Koongarra have ovarian eggs only. Two adult males from Cox River Station (NTM-A/S R411, AM R65113) collected in July 1977 have the testes enlarged, while those taken at Koongarra in February 1973 (AM R38855-6) do not have them enlarged. Of the 17 paratypes collected in February 1973 at Koongarra, five specimens are smaller than 30 mm SVL. These specimens may be regarded as very young juveniles, but the size at birth is uncertain.

REMARKS: *Ctenotus vertebralis* has been previously regarded by Cogger (1975) as constituting juvenile *C. inornatus*. As the distribution of *C. inornatus* competely overlaps that of *C. vertebralis*, and because *C. inornatus* is a much larger species than *C. vertebralis*, this did not seem entirely unrealistic at the time. The holotype of *Hinulia inornata*, British Museum (Natural History) No. 1946.8.15.45, has a SVL = 66mm (Rankin, pers. obs.), and Storr (1970, 1975) gives the maximum size as 87mm SVL and 95mm SVL for N.T. and W.A. respectively. Further, gravid *C. inornatus* (Rankin, unpublished data) range from 65.0 — 78.0mm SVL (\bar{x} = 73.7, s.d. = 4.68, N = 6). To determine at what size *C. inornatus* becomes sexually mature, the entire series of Australian Museum specimens smaller than approximately 60mm SVL were dissected and their gonads examined (4 females, 17 males). The smallest female examined was 50mm SVL, and the smallest male 46mm SVL. None of the four females was determined to be sexually mature. The smallest sexually mature male was 56.5mm SVL, although some larger than this were immature.

The maximum size recorded for *C. vertebralis* is 55 mm SVL, and it has already been stated that individuals below this size are able to reproduce (see section on reproduction). In view of this fact, by implication, reproductive isolation between the two species seems almost certain.

C. vertebralis is also readily distinguished from *C. inornatus* by its much more prominent vertebral stripe than in equally sized *C. inornatus* (Fig. 6), by its total absence of pale upper lateral flecks or spots, by having fewer midbody scale rows (24-26 vs 27-34), and by having supraciliaries subequal in vertical depth. (See Storr, 1975, for a discussion on the shape of supraciliaries in his *inornatus* subgroup.)

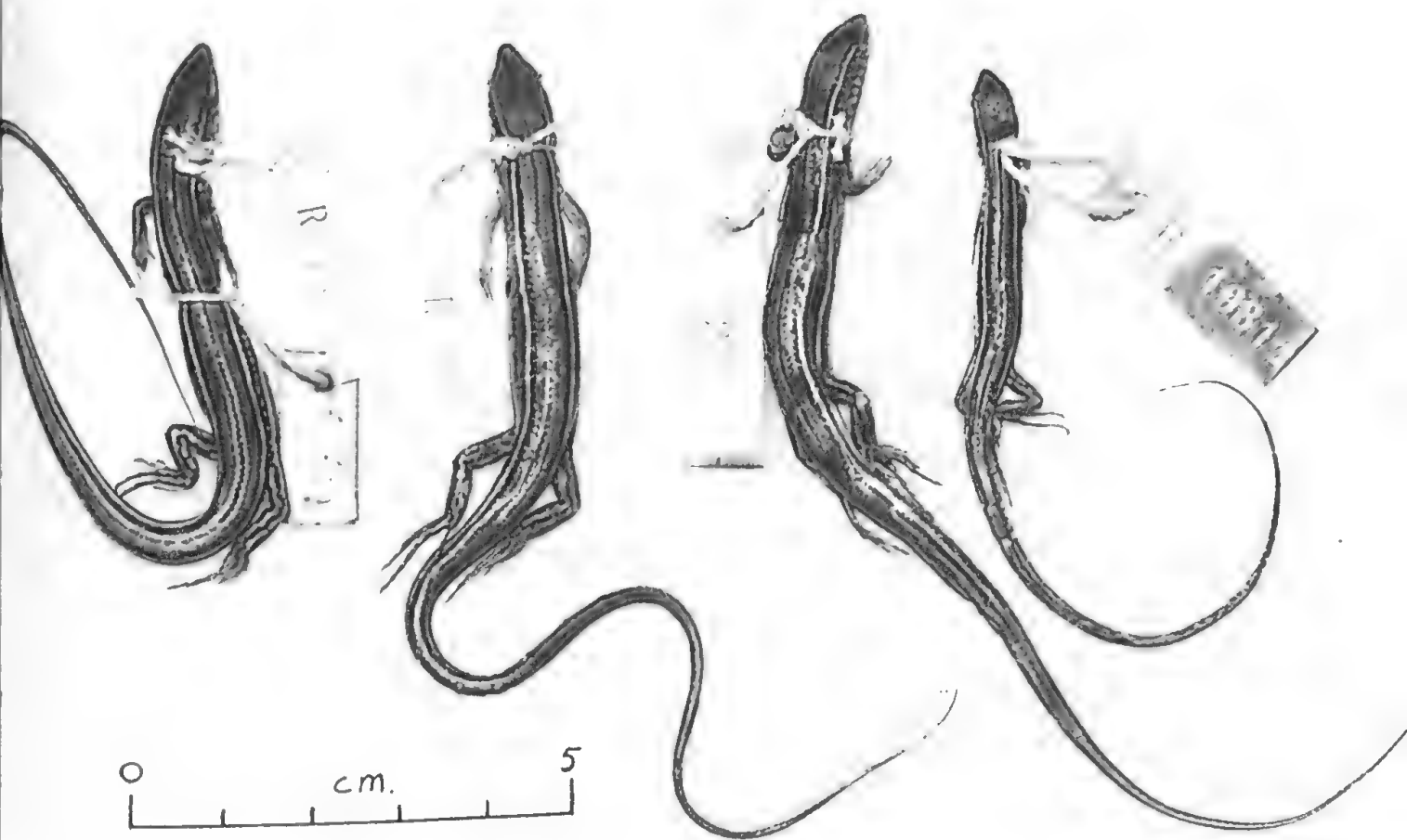


Fig. 6. A series of juvenile *Ctenotus inornatus* (Australian Museum specimens) showing variation in dorsal pattern. Localities (left to right): Forest River Mission, W.A.; Yirrkala, N.T.; Cape Arnhem, N.T. (two specimens).

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We gratefully acknowledge Dr H. G. Cogger and Dr A. Greer for critically reading the manuscript, Dr G. Storr for offering comment, Messrs B. Bolton and P. Latz for their assistance, particularly with the evaluation of the Cox River data, and Mr J. Wombey for the loan of specimens. We are further indebted to the trustees and staff of the Australian Museum, and to the Director of the Territory Parks and Wildlife Commission for providing facilities and permission to carry out the study.

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TABLE 1

Meristics and measurements of type series of *Ctenotus vertebralis*.

	Number	Range	Mean and Standard Deviation
SVL	22	24.5-55.0	40 ± 10
Tail (% of SVL)	8	190-266	236 ± 32
Forelimb (% of SVL)	22	24-33	29 ± 4
Hindlimb (% of SVL)	21	45-56	52 ± 5
Axilla-groin (% of SVL)	20	43-57	49 ± 7
Supraciliaries	22	6-8	7.2
Upper palpebrals*	22	9-12	9.5
Supralabials	22	7-8	7.9
Ear lobules	22	3-6	4.1
Nuchals	22	1-6	3.7
Midbody scale rows	22	24-26	24.8
Lamellae beneath 4th toe	21	20-25	22.5
Paravertebral scale rows**	21	51-62	57.5
Presuboculars	22	1-2	1.9
Infralabials contacting postmental	22	2-3	2.1

* Palpebrals of Storr (1969)

** The row of scales from the posterior margin of the parietals to the posterior margin of the hindlimbs.

PSILOPSOCIDAE AND MYOPSOCIDAE (INSECTA : PSOCOPTERA) OF THE BISMARCK ARCHIPELAGO, SOLOMON ISLANDS AND NEW HEBRIDES

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SUMMARY

This paper is part of a study of the Psocoptera of the Melanesian arcs; *Psilopsocus manus* sp. n. (Psilopsocidae), *Lophopterygella spilota* sp. n., *Mouldsia marmorata* sp. n., *Phlotodes brunneigena* sp. n. and *Ph. lineatus* sp. n. (Myopsocidae) are described from the Bismarck Archipelago and the male of *Myopsocus amplus* Smithers and Thornton is illustrated for the first time. From the Solomons are described *Phlotodes gregarius* sp. n., *Ph. megops* sp. n. and *Ph. anomalus* sp. n. and from the New Hebrides are described *Ph. platyvalvula* sp. n., *Ph. hoskinsi* sp. n. and *Ph. sagitta* sp. n. Additional records for described species are given from the Bismarcks and the Solomons and keys provided to the four genera of Myopsocidae and the species of *Phlotodes* Enderlein from each of the three island groups.

INTRODUCTION

This paper records psocopteran insects of the closely related families Psilopsocidae and Myopsocidae from the Bismarcks, the Solomons and the New Hebrides and is one of a series dealing with this order in the Melanesian arcs (see Smithers and Thornton 1974). Species from New Guinea and New Caledonia have already been dealt with (Smithers and Thornton 1973, 1974).

Psilopsocus Enderlein is the only genus at present placed in the Psilopsocidae, of which five species have been described, namely, *Ps. marmoratus* Smithers and Thornton, *Ps. nigricornis* Enderlein, *Ps. pulchripennis* Smithers and Thornton (all from New Guinea), *Ps. mimulus* Smithers (from Australia) and *Ps. nebulosus* Mockford (from the Philippines). A sixth species, known only from nymphal material (Smithers 1963) occurs in Natal, South Africa. Psilopsocids do not seem to be common insects; extensive collecting in eastern Australia has yielded very few specimens of *Ps. mimulus*. The peculiar, sclerotized, apex of the abdomen of the nymph (Smithers 1963), figs. 8, 9) and the elongate form of the adult with its very long, narrow wings, suggest that this species may inhabit tunnels in wood. A seventh species has been taken in the Bismarcks and this is described below. Mockford (1961) has discussed the relationships of the Psilopsocidae indicating that the family is closely related to the Myopsocidae. From material so far available it seems that the family is best developed in the New Guinea-Bismarcks area with some extension to Australia, the Philippines and into Africa. It has not been taken in other archipelagos of the Melanesian arcs.

There are at present four genera in the Myopsocidae, *Myopsocus* Hagen, *Lophopterygella* Enderlein, *Phlotodes* Enderlein and *Mouldsia* Smithers. A key to these genera is given below. *Myopsocus*, with more than thirty species, has been recorded from all regions although some of the described species may, in fact, belong to

Phlotodes. *Lophopterygella*, with seven species, has been recorded from East Africa, Singapore, Formosa, Philippines, Marianas, Java, Bismarcks, Haiti and Australia. *Phlotodes*, the largest genus, with more than sixty described species, occurs in all regions. *Mouldsia* is known from three species from Australia, New Guinea and the Bismarcks. (AM) indicates material deposited in the Australian Museum, Sydney.

KEY TO THE GENERA OF MYOPSOCIDAE

1. Ocelli absent *Mouldsia* Smithers
 Ocelli present 2
2. Rs and M in hind wing fused for a length *Phlotodes* Enderlein
 Rs and M in hind wing joined by a crossvein 3
3. Margin of fore wing incurved between veins giving rise to a sinuous wing margin *Lophopterygella* Enderlein
 Margin of fore wing not incurved between veins; margin smoothly rounded *Myopsocus* Hagen

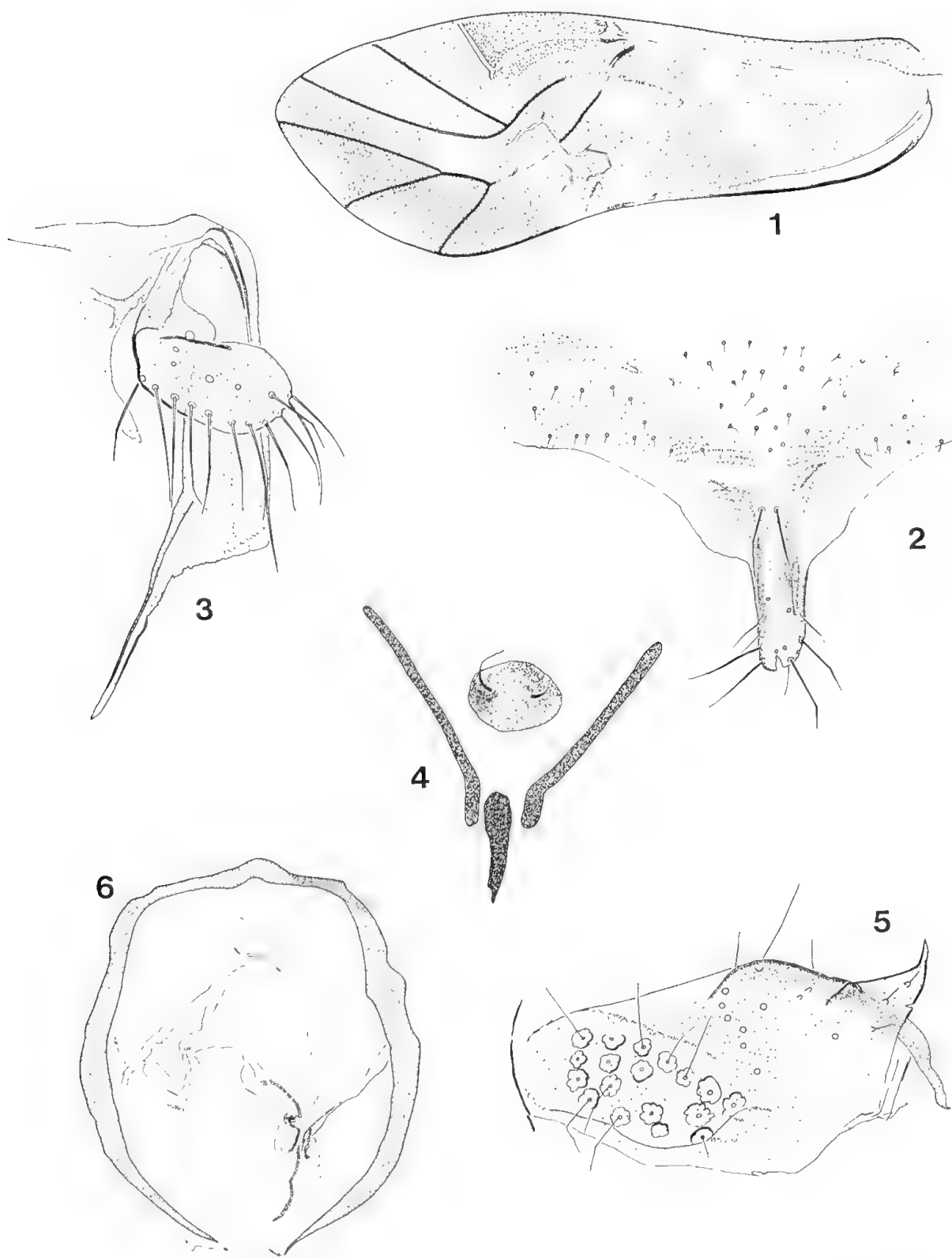
PSILOPSOCIDAE AND MYOPSOCIDAE FROM THE BISMARCK ARCHIPELAGO

PSILOPSOCIDAE

Psilopsocus manus sp. n

FEMALE: *Coloration* (in alcohol). Head very pale brown with darker markings. Median epicranial suture with brown on either side, the band so formed broadening posteriorly and the colour extending across the occipital area. Inner margins of compound eyes bordered with brown. A brown line marking the position of anterior arms of the epicranial suture. Frons with median V-shaped mark, the arms of the V reaching epistomial suture. Postclypeus brown with darker striations. Labrum dark. Scape and pedicel pale; flagellum almost black. Eyes black. Maxillary palp pale basally, third and fourth segments dark brown. Antedorsum brown with pale median line. Dorsal lobes pale but dark around edges; parapsidal sutures pale. Legs pale with dark tips to tibiae and dark tarsi. Fore wing (fig. 1) marked in various shades of brown. Hind wings hyaline, tinged brown, denser near anterior margin. Abdomen pale, terminal structures dark brown.

Morphology. Length of body: 3.0 mm. Median epicranial suture very distinct, anterior arms indistinct but position marked by a brown line. Length of flagellar segments: f_1 : 0.64 mm; f_2 : 0.68 mm. Eyes fairly large, reaching level of vertex. IO/D (Badonnel): 1.0; PO: 0.7. Anterior ocellus a little smaller than lateral ocelli. Measurements of hind leg: F: 0.52 mm; T: 1.0 mm; t_1 : 0.33 mm; t_2 : 0.056 mm; t_3 : 0.084 mm; rt: 6.0:1:1.5. Femur tapering a little distally; tibia broader distally than proximally. Fore wing length: 2.9 mm; width: 1.1 mm. Fore wing (fig. 1) with very short spurvein at hind angle of pterostigma. Stigmapophysis in form of a small, rounded, raised area. Areola postica small. Subgenital plate (fig. 2) with an apical lobe. Gonapophyses (fig. 3) with strongly developed ventral valve; dorsal valve broad in basal half, narrowing abruptly to a long tapering point. Entrance to spermatheca (fig. 4) with a pair of posteriorly converging, sclerotized rods and a median, posterior rod between their apices. Epiproct simple, rounded posteriorly, sparsely setose.



Figs. 1-6. *Psilopsocus manus* sp. n. 1. ♀ Fore wing; 2. ♀ Subgenital plate; 3. ♀ Gonapophyses; 4. ♀ Sclerification of entrance to spermatheca; 5. ♂ Paraproct; 6. ♂ Phallosome.

MALE: *Coloration* (in alcohol). Similar to female. Wing pattern very similar but with extent and density of patterns differing in minor respects.

Morphology. Length of body: 3.0 mm. Length of first flagellar segment: 0.56 mm. Eyes larger than in female; ratios not measured owing to damage to eye. Measurements of hind leg: F: 0.49 mm; T: 0.96 mm; t_1 : 0.3 mm; t_2 : 0.046 mm; t_3 : 0.084 mm; rt: 6.5:1:1.8; ct: 13, 1, 1. Femur distinctly tapering towards ends; tibia much narrower basally, broadening distally with row of strongly developed ctenidiobothria along whole length of inner margin. Basal tarsal segment slightly curved. Fore wing length: 2.7 mm; width: 0.90 mm. Fore wing form and venation as in female. Epiproct triangular with the basal margin developed into a well sclerotized ridge, the sclerotization extending along lateral margins, decreasing in thickness but becoming broader towards apex. Paraprocts (Fig. 5) with very strongly sclerotized dorsal ridge and pointed apophysis. Hypandrium simply rounded behind, fairly well sclerotized. Phallosome (Fig. 6) simple, in the form of an anteriorly interrupted ring with some very slight thickening of the penial bulb.

MATERIAL EXAMINED. ADMIRALTY ISLANDS. MANUS IS: 2♀ (including holotype), 1♂ (allotype), forested gully, Karon, c. 300 m. 7.xi.1974 (T. R. New and I. W. B. Thornton); 1♀ same locality, 6.xi.1974 (T. R. New and I. W. B. Thornton); 2♀ Rossun area, 7.xi.1974 (T. R. New and I. W. B. Thornton).

Holotype, allotype and paratypes in the Australian Museum.

DISCUSSION: *Psilopsocus manus* can be distinguished from all other species of the genus by its wing pattern, the palest areas being near the wing base whereas in other species the basal area is well pigmented. *Ps. manus* most resembles *Ps. marmoratus* but differs in having few terminal setae on the lobe of the subgenital plate. From *Ps. pulchripennis* it differs in the form of the hypandrium, epiproct lobe and phallosome. From *Ps. nigricornis* it differs in having a long, narrow, distal section to the dorsal valve, that of *Ps. nigricornis* narrowing more gradually. *Ps. nebulosus* is a much larger species (wing length 4.4-4.6 mm). In the key provided in Smithers and Thornton (1973) *Ps. manus* would run to *Ps. nigricornis* from which it differs in wing pattern and genitalic characters.

MYOPSOCIDAE

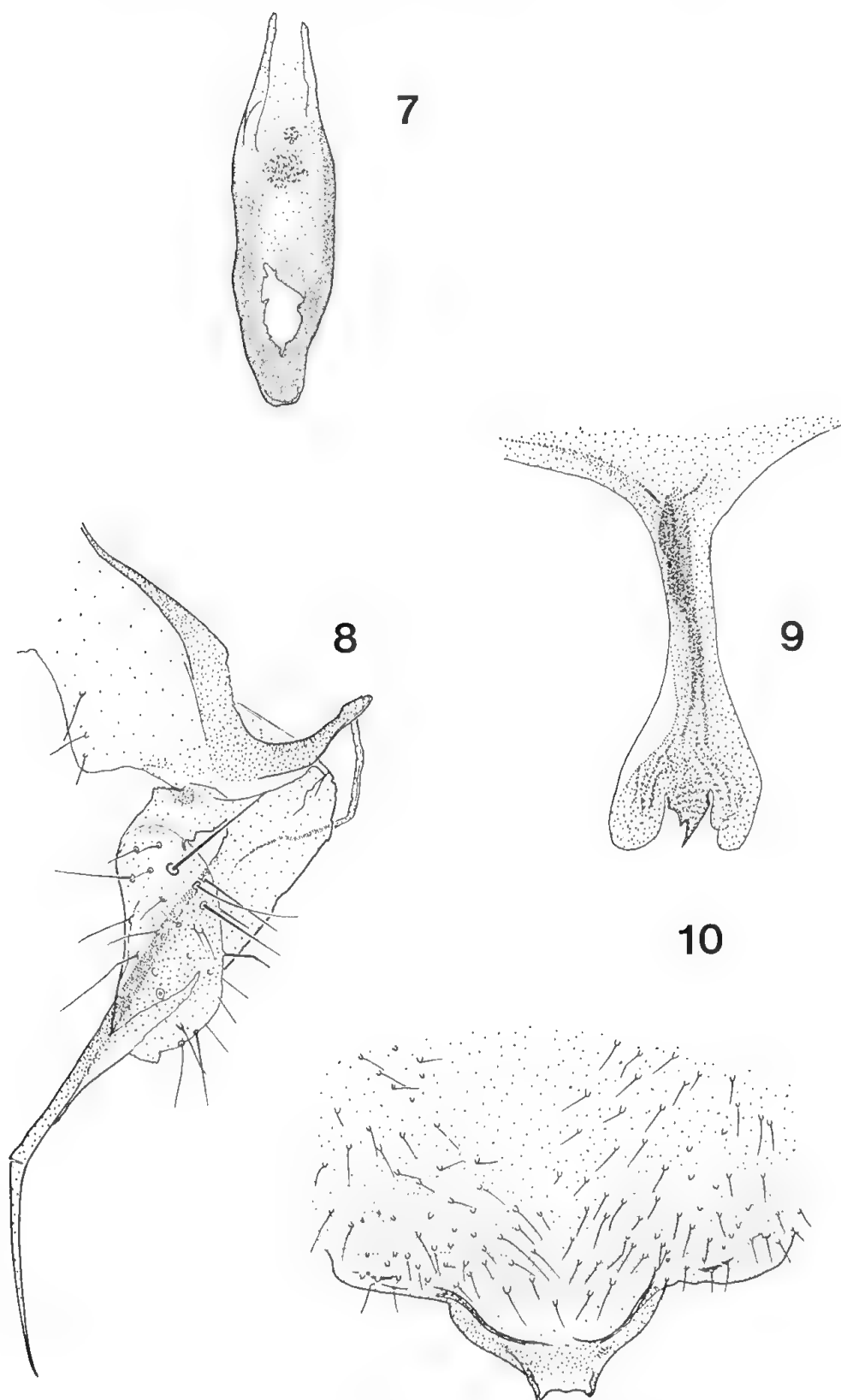
Myopsocus amplus Smithers and Thornton.

MALE: Male material was not available when this species was described from several localities in New Guinea (Smithers and Thornton, 1974). Three males are associated with females of *M. amplus* in the present material; the characteristic elongated phallosome, with tapering external parameres, is illustrated in Fig. 7.

MATERIAL EXAMINED. NEW BRITAIN: 3, ♂ 3, ♀ Gazelle Peninsula, Baining, St. Paul's, 350 m, 6.ix.1955 (J. L. Gressitt); 1 ♀, Malmaluon — Vunakanau, Gazelle Peninsula, 17.v.1956, (J. L. Gressitt). One of the above males from Baining, is in the Australian Museum collection. This species is known also from northern Australia and New Guinea.

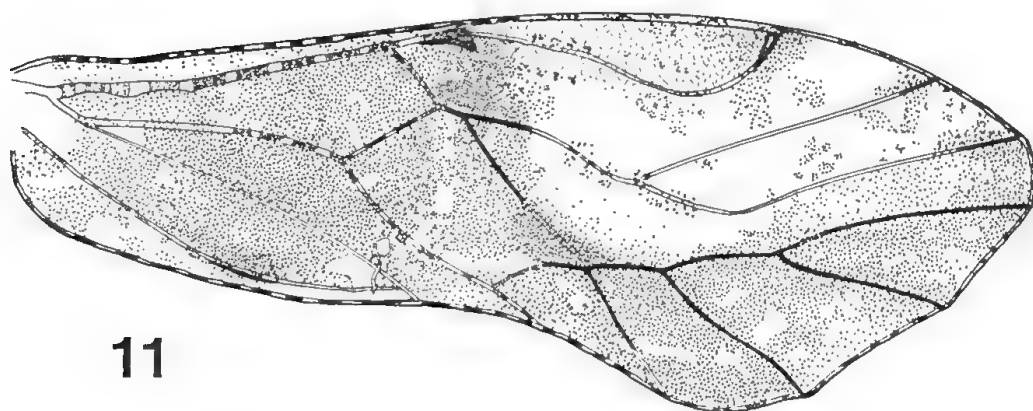
Lophopterygella spilota sp. n.

MALE: *Coloration* (in alcohol). Head pale brown with brown markings. Vertex with irregular spots on either side of the median epicranial suture and adjacent to the compound eyes; an irregular dark patch on either side of ocellar triangle; a fine but broadening line from ocellar triangle to compound eye; a sinuous line from compound eye running mesad of antenna base to epistomial suture. Postclypeus spotted.

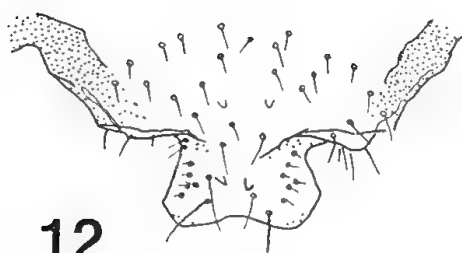


Figs. 7-10. 7. *Myopsocus amplus* Smithers and Thornton Phallosome. ♂

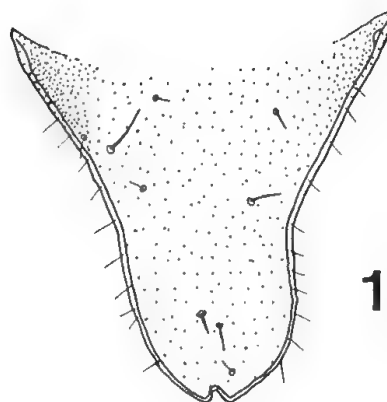
Figs 8-10. *Lophopterygella spilota* ♀ sp. n. 8. Gonapophyses; 9. 9th sternite; 10. Subgenital plate.



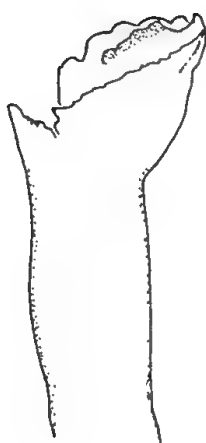
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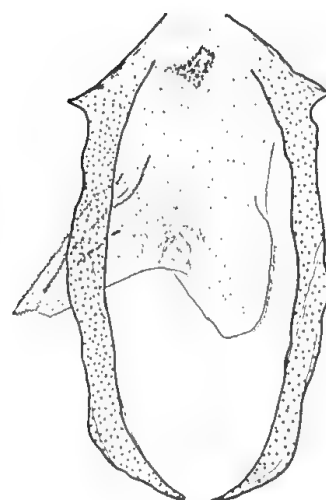
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15

Figs. 11-15. *Lophopterygella spilota* ♂ sp. n. 11. Forewing; 12. Hypandrium; 13. Epiproct; 14. Lacinia; 15. Phallosome.

Anteclypeus dark basally, pale distally. Labrum pale laterally, darker toward middle. Genae pale anteriorly, dark posteriorly. Flagellar segments of antenna banded in various shades of brown, the bands not of uniform width but varying from segment to segment. Eyes black. Maxillary palps pale except for dark tip to fourth segment. Mesonotum dark brown except for a fine, median, pale line. Femora pale with three dark bands on first and second legs, four such bands on hind legs. Tibiae pale with very dark, almost black tips. First tarsal segment on first and second legs pale in basal part but darker distally; uniformly pale in hind legs; second and third segment dark in all legs. Fore wing (Fig. 11) with complex pattern in various shades of brown with the pale submarginal band usually present in this genus broken into a series of small pale patches. Abdomen pale with some irregular brown markings.

Morphology. Length of body: 2.6 mm. Median epicranial suture distinct, anterior arms indistinct. Frons deep. Lengths of flagellar segments: f_1 : 1.0 mm; f_2 : 1.08 mm. Antennae fine with long fine setae. Eyes large, reaching above level of vertex. IO/D (Badonhel): 0.9; PO: 0.9. Lacinia (Fig. 14) stout with numerous apical teeth. Measurements of hind leg: F: 0.72 mm; T: 1.48 mm; t_1 : 0.53 mm; t_2 : 0.07 mm; t_3 : 0.098 mm; rt: 7.6:1:1.4; ct: 22, 1, 1. Hind tibia slightly curved, ctenidia along lower margin strongly developed and arranged in a row. Fore wing length: 3.0 mm; fore wing width: 1.1 mm. Fore wing with one "pocket" on 1A and the marginal curvature between the ends of branches of M slight but obvious. Rs and M fused for a short length; Cu_{1a} and M meet in a point. Cu_{1a} arising well basad of point at which Cu_{1b} reaches margin. In hind wing Cu_2 approaches Cu_1 in middle. Flap on epiproct (Fig. 13) tapering with sinuous lateral margins and a small apical notch. Hypandrium (Fig. 12) with lateral margins strongly sclerotized and bearing a short, broad, apical lobe. Phallosome (Fig. 15) simple, elongate, without sclerification of the penial bulb.

FEMALE: One very badly damaged specimen is available of which the subgenital plate (Fig. 10), gonapophyses (Fig. 8) and sclerification of the ninth sternite (Fig. 9) are illustrated. It was probably a little larger than the male holotype and the wing pattern seems to be very similar.

MATERIAL EXAMINED. NEW BRITAIN: 1♂ (holotype), 8 km E. Keravat, ex *Araucaria*, 17.xi.1974 (T. R. New and I. W. B. Thornton); 1♂ (paratype), Gazelle Peninsula, Talili Gap, c. 210 m, 16.xi.1974 (T. R. New and I. W. B. Thornton). NEW IRELAND: 1♀ (allotype), Gilingil Plantation, 2 m, 6.vii.1956 (J. L. Gressitt).

Holotype and paratype in the Australian Museum; allotype in the Bishop Museum.

DISCUSSION: *Lophopterygella spilota* differs from *L. lobata* New and Thornton (from Singapore) in having a broken, submarginal, pale band on the fore wing; this band is lacking in *L. lobata* which is also much larger (wing length 5.4 mm as opposed to 3.0 mm in *L. spilota*). In *L. camelina* Enderlein (from Java, southeast Asia, Philippines and Formosa) and *L. bursulipennis* Enderlein (from East Africa) the pale submarginal band is almost continuous with an inward curvature at each vein. In *L. spilota* the band is broken into short sections. In *L. cincticornis* Thornton, Lee and Chui (from the Marianas) the band is broken into two sections, one from R_4+5 to M_2 and another from M_3 to Cu_{1a} , that is, the band is broken in cell M_2 . *L. spilota* resembles *L. petersi* Smithers (from Australia) but can be distinguished by the form of the submarginal band as well as the differences in form of the lobe of the hypandrium; in *L. spilota* it is broadly attached to the body of the hypandrium but in *L. petersi* the attachment is much narrower. In *L. petersi* the apex of the epiproct lobe is inwardly curved whereas in *L. spilota* it is notched. Although the phallosomes are similar in the two species that of *L. spilota* is relatively a little longer.

***Mouldsia marmorata* sp. n.**

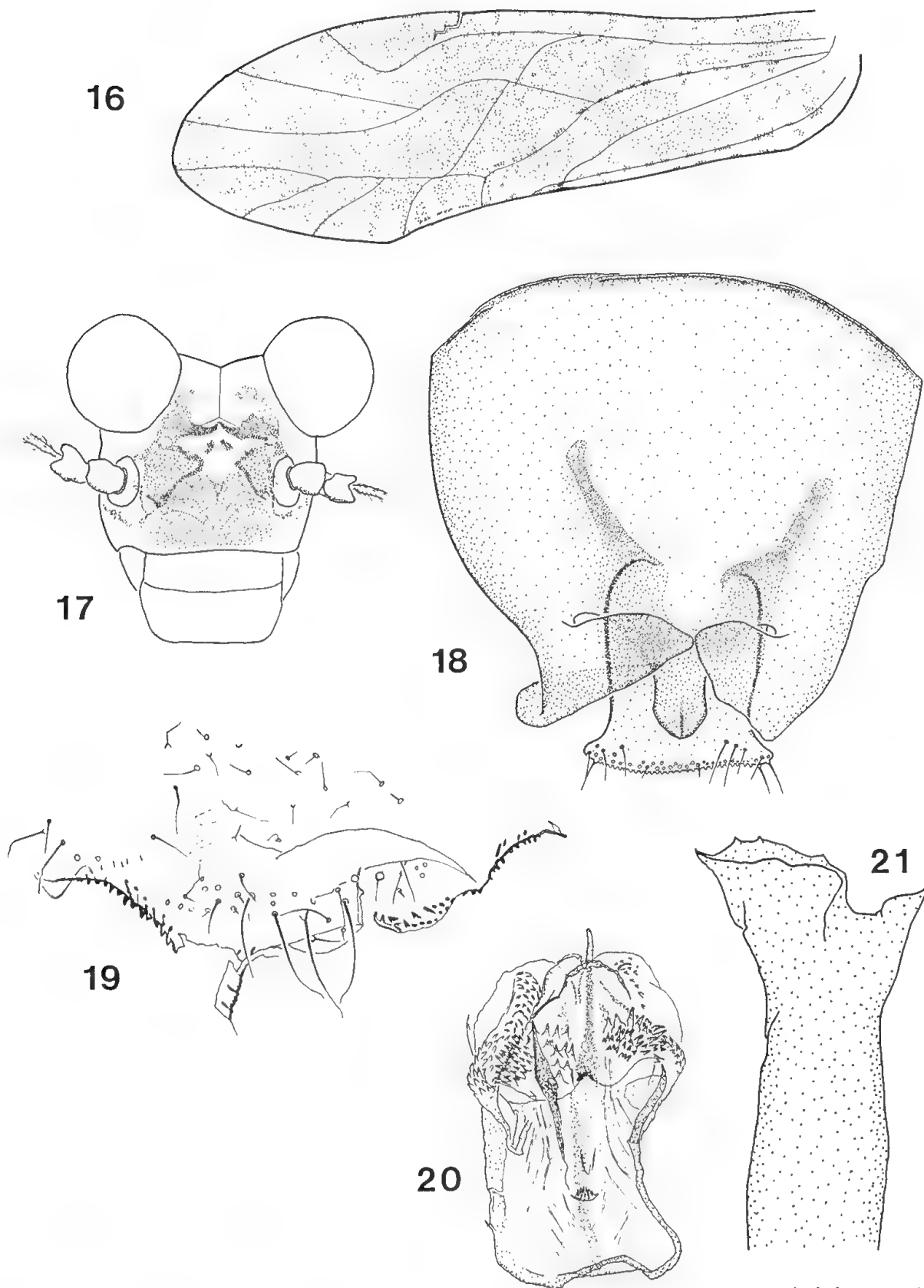
MALE: Coloration (in alcohol): Head (fig. 17) with pale vertex and a characteristic pattern on front of head. Genae pale with two transverse brown bands, one at antenna level and the other nearer base of mandible. Eyes black. Antennae pale. Maxillary palps pale. Femora pale with a faint transverse band in middle, tibiae very pale with a short black band near middle. Basal tarsal segment pale, second and third brown. Mesothorax pale dorsally, with a brown patch on each dorsal lobe. A broken, dark lateral line runs through pleura. Fore wing (fig. 16) hyaline marked with a pale pattern in various shades of brown. Abdomen pale with segmentally arranged, dark brown, transverse bands dorsally in basal two thirds.

Morphology: Length of body: 2.3 mm. Median epicranial suture distinct, in furrow between large eyes. Postclypeus almost flat. Length of flagellar segments: f_1 : 1.0 mm.; f_2 : 1.04 mm. Scape and pedicel very much thicker than flagellar segments. Eyes extremely large. IO/D (Badonnel): 0.54; PO: 1.0. *Ocelli absent*. Antennae fine; setae fine, alveoli not particularly conspicuous. Lacinia (fig. 21). Measurements of hind leg: F: 0.46 mm; T: 1.32 mm; t_1 : 0.46 mm; t_2 : 0.07 mm; t_3 : 0.10 mm; rt: 6.6:1:1.4; ct: 23, 1, 1. Tibia of hind leg broadened a little at distal end. Fore wing length: 2.9 mm; width: 0.9 mm. Fore wings (fig. 16) narrow, broadest opposite distal end of pterostigma. R_1 curving slightly before broadest part of pterostigma. Basal section of Sc evanescent. Rs and M fused for a length. Apex of areola postica fused with M for a length. Cu_{1b} very distinct and about half as long as first section of Cu_{1a} ; distal section of Cu_{1a} curving slightly backward to meet wing margin. Cu_2 meets IA before end of latter near wing margin; at point of fusion IA and adjacent wing margin thickened. Hind wing length: 2.3 mm; width: 0.84 mm. Rs and M fused for a length; M separating from Rs beyond fusion at an acute angle. Apex of abdomen (fig. 18) complex; ninth tergite strongly sclerotized and sparsely setose, the setae very fine; a large lobe which overlies the base of the epiproct arising from near posterior margin on each side. Ninth tergite extended medially into a posterior, rounded lobe. Epiproct (fig. 18) lightly sclerotized, glabrous except near posterior margin, with sinuous, well sclerotized, lateral margins. Posterior margin sclerotized, bearing setae which arise from conspicuously raised alveoli; a large median, broadly rounded lobe arising from the base of the epiproct. Paraprocts with narrow basal attachment, with large lightly sclerotized posterior lobe. Hypandrium (fig. 19, damaged in preparation) well sclerotized, setose; hind margin with small teeth laterally, three large setae arise in middle near posterior margin. Phallosome (fig. 20) closed anteriorly with median sclerotized bar and a strong posteriorly tapering, well sclerotized, median rod; penial bulb developed into two lobes which are spiculate and bear tooth-like projections.

MATERIAL EXAMINED. NEW BRITAIN: 1♂ (holotype), Hoskins area, Kapiula Forest, Kasiloli, 19.xi.1974 (T. R. New and I. W. B. Thornton).

Holotype in the Australian Museum.

DISCUSSION: Two other species of *Mouldsia* are known, *M. inocellata* (Smithers and Thornton) (known from female only) from New Guinea and *M. barbarae* Smithers from Queensland. In *M. inocellata* the facial pattern is simple, being dark brown with a row of four small pale spots in line between the eyes and with the vertex pale; in *M. marmorata* the pattern is more complex (Fig. 17); also, wing pattern differs in details. *M. marmorata* can be distinguished from *M. barbarae* on facial pattern. In the latter species the postclypeus is striped and the lower part of the gena dark brown; the eyes are further apart and relatively larger in *M. marmorata* (IO/D: 1.1; PO: 1.0 in *M. barbarae*; IO/D 0.54; PO: 1.0 in *M. marmorata*). In *M. marmorata* the male ninth tergite is extended into a posteriorly directed median lobe which is absent in *M. barbarae* and the posterior edge of the epiproct is clearly tuberculate but only slightly so in *M. barbarae*.



Figs. 16-21. *Mouldsia marmorata* ♂ sp. n. 16. Forewing; 17. Head; 18. Apex of abdomen; 19. Hypandrium; 20. Phallosome; 21. Lacinia.

KEY TO THE SPECIES OF *PHLOTODES* FROM THE BISMARCKS

1. Postclypeus with anteriorly converging stripes 2
 Postclypeus marked but not with converging stripes 3
2. Hind femur pale; small dark spot in distal half. ♂ hypandrium simple.
 ♀ subgenital plate without preapical setae on posterior lobe but with two
 terminal setae *maculatus*
 Hind femur dark in basal half, distal half pale with narrow dark apical band. ♂
 hypandrium 3-lobed. ♀ subgenital plate with preapical setae on
 posterior lobe in addition to two terminal setae *kolbei*
3. Genae entirely dark brown *brunneigena*
 Genae not entirely dark brown, pale at least in posterior half 4
4. Postclypeus mostly dark brown, the mark forming a broadly V-shaped pattern.
 In fore wing cell R₃ with few dark spots *platyvalvula*
 Postclypeus without V-shaped mark but with some irregular dark spotting in
 fore wing cell R₃ heavily spotted 5
5. Membrane in basal area of cell R₃ (in fork) and between forking and apex of
 areola postica hyaline *preclarus*
 Membrane in basal area of cell R₃ (in fork) and between forking and apex of
 areola postica with dark spots *lineatus*

***Phlotodes kolbei* (Enderlein)**

MATERIAL EXAMINED. NEW BRITAIN: 1♂, 3♀, 8 km E. Keravat, ex *Araucaria* sp., 17.xi.1974 (T. R. New and I. W. B. Thornton); 1♂, Gazelle Peninsula, Toma area, 300 m, 16.xi.1974 (T. R. New and I. W. B. Thornton) (AM). Known also from New Guinea.

***Phlotodes maculatus* Smithers and Thornton**

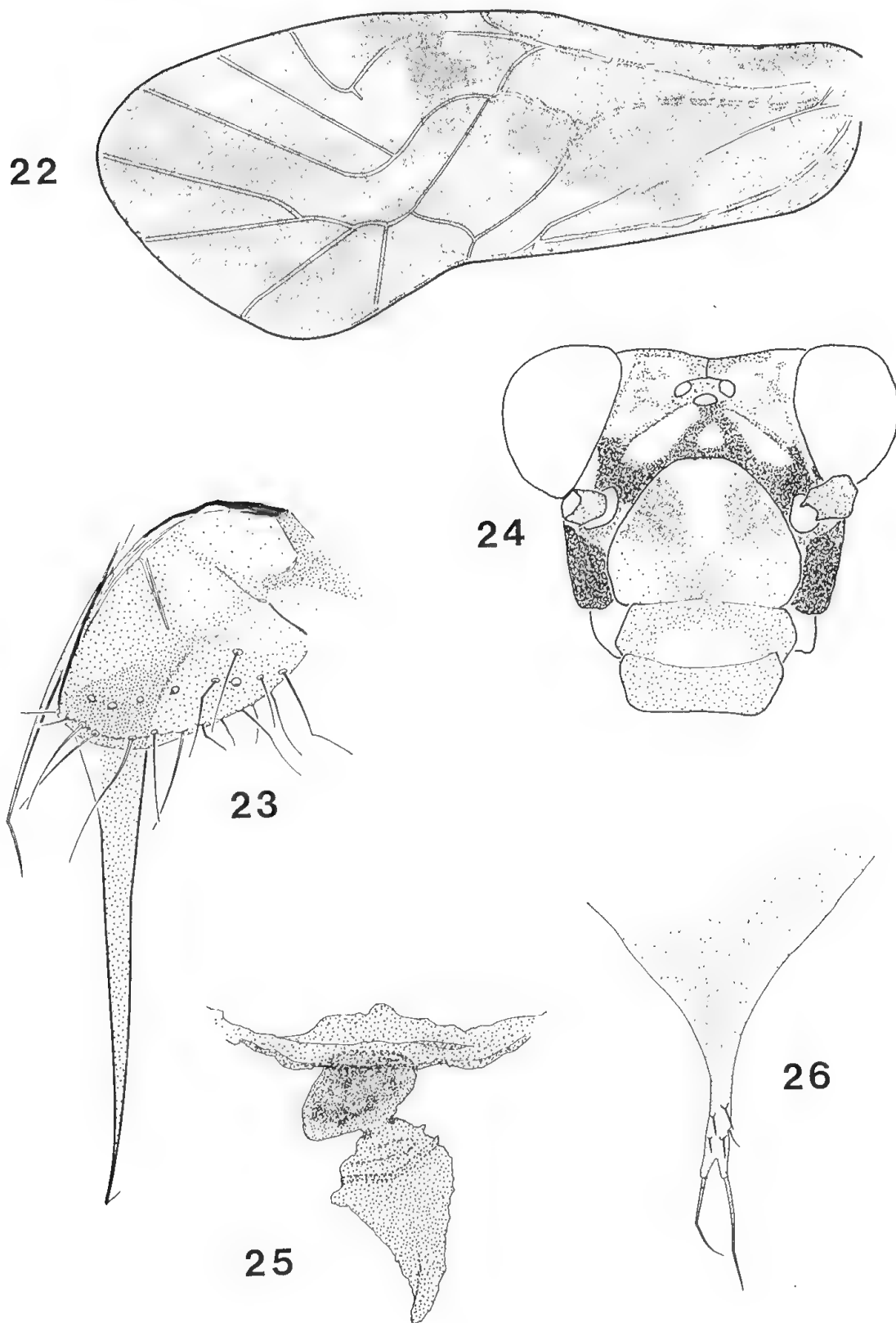
MATERIAL EXAMINED. NEW BRITAIN: 1♀, Cape Gloucester area, 21.xi.1974 (T. R. New and I. W. B. Thornton) (AM). Known also from New Guinea.

***Phlotodes preclarus* Smithers and Thornton**

MATERIAL EXAMINED. NEW BRITAIN: 1♂, Gazelle Peninsula, Talili Gap, 210 m., 16.xi.1974 (T. R. New and I. W. B. Thornton) (AM); 1♀, Gazelle Peninsula, Malmaluan-Vunakanau, 5-12.v.1956 (J. L. Gressitt) (Bishop Museum); 1♀, 8 km E. Keravat, ex *Araucaria klinkii*, 17.xi.1974 (T. R. New and I. W. B. Thornton). MANUS ISLAND: 1♂, Karon, 304 m, forest gully, 7.xi.1974 (T. R. New and I. W. B. Thornton). NEW GUINEA: 1♂, Maprik, Sepik district, 1958 (Malaria Control project) (AM). This species was described from specimens from New Guinea and has also been taken in the Solomons (Guadalcanal).

***Phlotodes brunneigena* sp. n.**

FEMALE: *Coloration* (in alcohol). Head pale brown with darker brown markings (fig. 24). Scape brown, pedicel pale, first flagellar segment pale (remainder of antennae missing). Eyes black. Maxillary palps entirely brown. Antedorsum dark brown with pale



Figs. 22-26. *Phlotodes brunneigena* ♀ sp. n. 22. Forewing; 23. Gonapophyses; 24. Head; 25. Spermathecal entrance; 26. Subgenital plate.

median line; dorsal lobes mottled in dark and pale brown. Femora pale, with dark distal tip; tibiae pale, a little darker at distal end; first tarsal segment pale, second and third dark brown; coxae pale. Pleura of thorax dark brown. Fore wings (fig. 22) hyaline with complex pattern in various shades of brown. Hind wings hyaline, veins brown, basal parts of Rs and M being particularly dark.

Morphology: Length of body: 2.3 mm. Median epicranial suture distinct especially on top of head; anterior arms evanescent although a pigmented line suggests their position. Antennae broken. Eyes fairly large, reaching level of vertex. IO/D (Badonnel): 1.2; PO: 0.83. Measurements of hind leg: F: 0.65 mm; T: 1.24 mm; t_1 : 0.45 mm; t_2 : 0.07 mm; t_3 : 0.08 mm; rt: 6.4:1:1.1; ct: 20, 1, 1. Fore wing length: 3.3 mm; width: 1.3 mm. Costal margin somewhat sinuous basad of pterostigma. Pterostigma very strongly angled behind. Rs and M meeting in a point. Cu_{1a} and M fused for a length. 1A meets Cu_2 a little before wing margin. Epiproct simple, setose, a row of four strong setae across posterior third, posterior to which is a group of three small, closely spaced median setae. Paraprocts with a circular field of trichobothria in the middle of which are two setae with poorly developed "rosettes"; posterior to the trichobothrial field is a very strong, long, seta. Subgenital plate (fig. 26) with a long posterior extension bearing two strong apical setae, each arising from a tubercle; basad of the apical setae are a few small, fine setae arising from the posterior lobe of the plate; these do not protrude laterally from the lobe. Gonapophyses (fig. 23). Spermethecal entrance (fig. 25).

MATERIAL EXAMINED. MANUS ISLAND: 1 ♀ (holotype), Rossun area c. 243 m, 7.xi.1974 (T. R. New and I. W. B. Thornton).

Holotype in the Australian Museum.

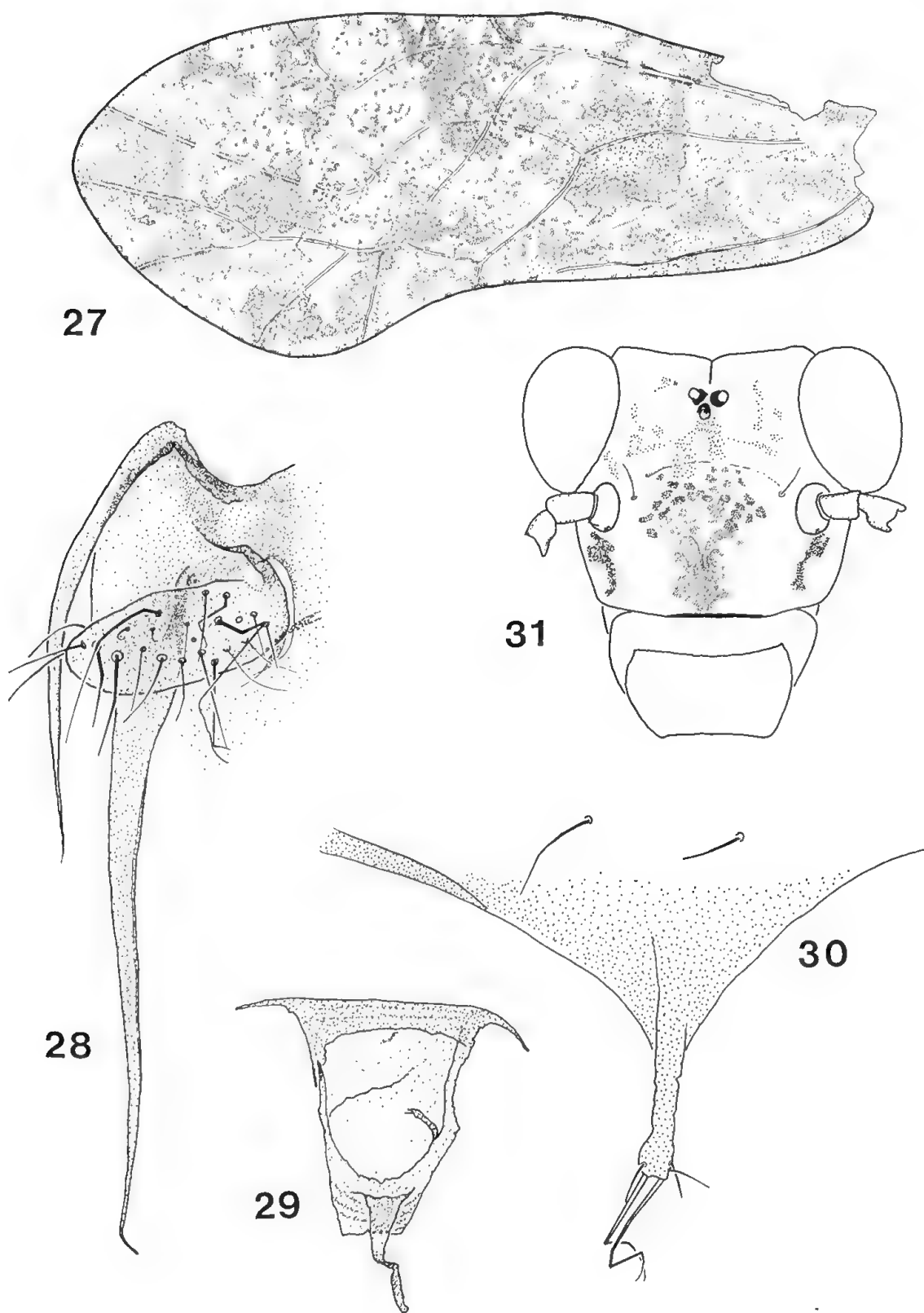
***Phlotodes platyvalvula* Smithers and Thornton**

MATERIAL EXAMINED. NEW BRITAIN: 1 ♀, Talili Gap, Gazelle Peninsula, c. 200 m, 16.xi.1974 (T. R. New and I. W. B. Thornton) (AM). Description of this species is given below (page 537) on material from the New Hebrides (Tanna, Erromanga and Efate).

***Phlotodes lineatus* sp. n.**

FEMALE: Coloration (in alcohol). Head (fig. 31) pale with a dark patch of variable width from ocellar triangle to anteclypeus, the patch made up of spots. A few spots on either side of median epicranial suture. An irregular dark line from antenna base to anterior angle of mandible. Ocellar triangle black. Eyes black. Antennae pale. Maxillary palp pale with a slightly darker fourth segment. Femora pale with two dark bands in distal half; femora pale with apices a little darker; basal segment of tarsi pale, second and third segments brown. Fore wing (fig. 27) with complex pattern in various shades of brown.

Morphology: Length of body: 3.1 mm. Median epicranial suture very distinct. Ocellar triangle large. Eyes large, reaching level of vertex. IO/D (Badonnel): 1.4; PO: 0.91. Eyes diverging strongly behind when viewed from above. Measurements of hind leg: F: 0.72 mm; T: 1.3 mm; t_1 : 0.47 mm; t_2 : 0.07 mm; t_3 : 0.05 mm; rt: 6.7:1:1.4; ct: 17, 0, 0. Fore wing length: 3.7 mm; width: 1.4 mm. Stigmapophysis poorly developed. Pterostigma with strongly curved hind margin. Rs and M meet in a point, with Rs curved before fusion with M; Cu_{1a} and M fused for a length. Hind wing length: 2.4 mm. Rs and M fused for a fairly long distance with M curving, leaving Rs at right angle and curving in a wide arc towards hind margin. Paraproct with a group of very long setae on rounded apex. Subgenital plate (fig. 30) with a long, parallel-sided posterior projection terminating in two long, fine, apical setae just basad of which arise four small setae.



Figs 27-31. *Phlotodes lineatus* sp. n. ♀ 27. Forewing; 28. Gonapophyses; 29. Spermathecal entrance; 30. Subgenital plate; 31. Head ♀.

Gonapophyses (fig. 28) with lightly sclerotized ventral valve; dorsal valve very long, tapering to a fine point; external valve short, with rounded apex, setose. Sclerifications at entrance to spermatheca very characteristic (fig. 29).

MATERIAL EXAMINED. NEW BRITAIN: 1♀ (holotype), Gazelle Peninsula, Toma area, c. 300 m. 16.xi.1974 (T. R. New and I. W. B. Thornton).

Holotype in the Australian Museum.

DISCUSSION AND COMPARISONS OF SPECIES OF *PHLOTODES* FROM THE BISMARCKS

Using venational and genitalic characters, Smithers and Thornton (1974, p. 124) defined four species groups and assigned over thirty of the known species of *Phlotodes* to the groups. Unfortunately, many of the described species are known from one sex only or their descriptions do not include mention of genitalia so they cannot be placed with certainty. The species described here, like those from New Guinea that are assignable to groups, do not belong to the groups III or IV. As males are not available for *Ph. brunneigena* and *Ph. lineatus* it is not possible to determine to which of groups I or II they belong. *Ph. platyvalvula* appears to belong to group I. Members of this genus have very complex, often attractive, wing patterns made up of patches and spots of various sizes and shapes which make the insects very inconspicuous on bark. The patterns are too complex for verbal description of the differences to be helpful in most cases although differences are often easily appreciated in illustrations. There is a tendency for the pattern to include a more or less distinct broad band running from the area just basad of the pterostigma across the wing to the area of the anal cell basad of the nodulus. This band is usually outlined by darkening of its irregular edges. Of the species of *Phlotodes* included in groups I and II from New Guinea and New Caledonia only *Ph. preclarus* Smithers and Thornton (New Guinea) has this band clearly developed. It is also developed in the two species described here. Perusal of the figures of wings and genitalia in this paper will provide distinguishing features by which the two new species can be recognized. In *Ph. lineatus* the transverse band is broken at Cu_2 and there are concentrations of dark spots adjacent to the branches of R_s and M . In *Ph. brunneigena* the band is not so broken and the concentration of colour near the vein branches not apparent. In *Ph. platyvalvula* the pattern is generally intense but there is an irregular, small, dark area behind the basal end of the pterostigma which stands out as a dark mark on the wing. Females of all six species of *Phlotodes* known from the Bismarcks are available; the males of *Ph. brunneigena* and *Ph. lineatus* are unknown. Only *Ph. kolbei* and *Ph. brunneigena* have entirely dark genae but these two species can be distinguished from each other on features of facial pattern. In *Ph. kolbei* the postclypeus is striped whereas in *Ph. brunneigena* it is pale with some diffuse brown areas. In *Ph. brunneigena* cell R_3 is lightly pigmented whereas in *Ph. kolbei* it is as strongly patterned as the other distal cells. *Ph. preclarus* is the only species from the Bismarcks with a heavily patterned wing in which the centre of membrane (i.e. the area behind the pterostigma around R_s fork and the adjacent part of cell R_5) is hyaline and stands out in strong contrast to the rest of the wing. In *Ph. maculatus* the posterior lobe of the subgenital plate is short and without preapical setae although the two terminal setae are strong with a tubercle between their bases; in the other species the lobe is long and bears small preapical setae. The male palpallosome of *Ph. maculatus* is remarkable in being Y-shaped, the stem of the Y is very narrow and the arms are considerably expanded, thickened and apically incurved; the penial bulb is lightly and irregularly sclerotized between the distal expansions of the external parameres. The phallosome of *Ph. platyvalvula*, like that of *Ph. kolbei* and *Ph. preclarus*, is circular to ovoid in outline with a longitudinal, median

sclerotized bar. In *Ph. preclarus* the phallosome frame is almost circular with a more or less evenly developed but narrow rim; in *Ph. kolbei* it is a little narrower and has a thick rim with the distal parts of the external parameres broader than the proximal parts of the rim. In *Ph. platyvalvula* the phallosome is somewhat elongate, narrower anteriorly than posteriorly with an evenly developed rim and with the median rod distally expanded. In *Ph. lineatus* the dorsal valve of the female gonapophyses is very long and fine; in *Ph. platyvalvula* it is curved at the end whilst in *Ph. preclarus* the ventral valve is extremely short. There are differences in head and wing pattern; *Ph. lineatus* has a pale head with a few, irregular facial markings.

MYOPSOCIDAE FROM THE SOLOMONS

KEY TO SPECIES OF *PHLOTODES* FROM THE SOLOMONS

1. Postclypeus with distinct, clearly developed stripes *australis*
 Postclypeus, if marked, without striped pattern 2
2. Postclypeus almost uniformly brown; a dark irregular mark from epistomial suture to compound eye mesad of antenna base *anomalus*
 Postclypeus pale with some dark marks, sometimes indistinct 3
3. Front of head with distinct pattern.....
 darker, indistinct spots in midline *gregarius*
 Front of head with distinct pattern..... 4
4. Epicranial plate without marks on top of head *megops*
 Epicranial plate with some markings mesad of eyes on top of head *preclarus*

Phlotodes preclarus Smithers & Thornton

MATERIAL EXAMINED. SOLOMON ISLANDS: GUADALCANAL: 1♀, Honiara, 6.ix.1975 (I. W. B. Thornton); 1♂, near Honiara, 8.ix.1975 (I. W. B. Thornton); 2♂, Mt. Austen, 400 m, 14 ix 1975 (C. N. Smithers and I. W. B. Thornton) (AM).

This species is known to occur also in New Guinea, New Britain and Manus Island.

Phlotodes australis (Brauer)

MATERIAL EXAMINED. SOLOMON ISLANDS. GUADALCANAL: 1♀, Lambi, 3.ix.1975 (I. W. B. Thornton) (AM).

Ph. australis has been recorded from Australia (where it is a widespread and common species), New Zealand and Norfolk Island. It belongs to *Phlotodes* species Group IV (Smithers and Thornton 1974) which is a clearly defined Australian group; the occurrence of *Ph. australis* in New Zealand, Norfolk Island (where it is the only myopsocid) and in the Solomons, is probably due to recent introduction.

Phlotodes gregarius sp. n.

MALE. *Coloration* (in alcohol): Head (fig. 37) unusual for the genus in that the head is creamy white without markings except for a few brown spots across the occiput, brown, irregular markings on the hind part of the genae and a few, hardly discernible spots on the postclypeus. Antennae pale brown. Eyes black. Maxillary palp pale brown with dark

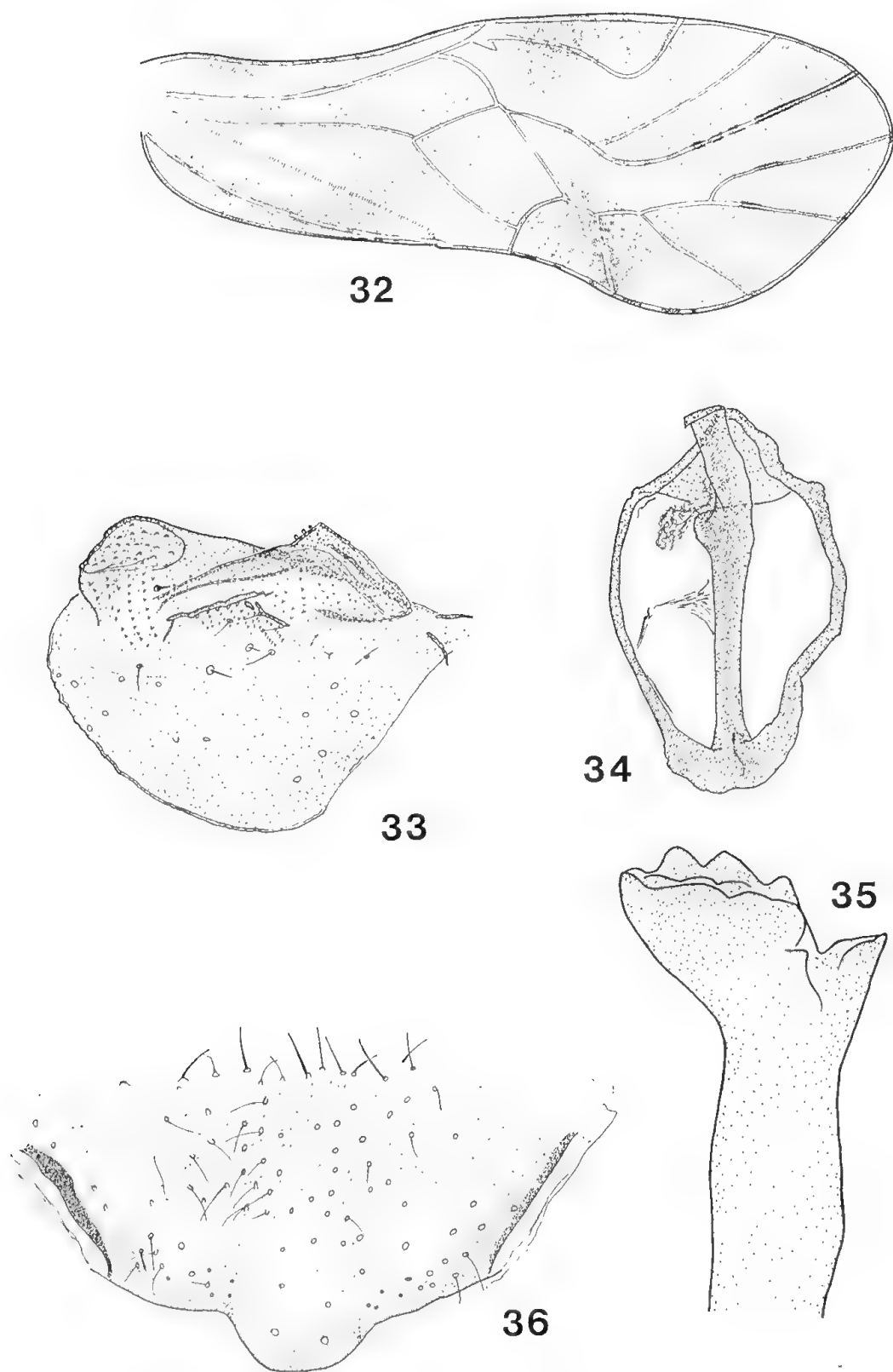
brown fourth segment. Pterothorax mottled brown above. Pleura mainly pale but with brown broken band below wing bases. Fore and middle femora dark brown with a narrow paler band at distal quarter, hind femur without band. Tibiae pale with dark distal tip. Tarsi with pale basal segment, second and third segments brown. Fore wings (fig. 32) with complex mottled brown pattern. Hind wings hyaline; abdomen pale, hypandrium very dark brown.

Morphology: Length of body: 2.2 mm. Median epicranial suture distinct, anterior arms not obvious. Head fairly heavily setose. Vertex narrow with median groove in which lies the epicranial suture. Epistomial suture indistinct. Head fairly short, narrow towards mandibles. Lengths of flagellar segments: f_1 : 0.80 mm.; f_2 : 0.60 mm. Eyes very large, with slightly sinuous margin near antenna bases. IO/D (Badonnel): 0.7; PO: 1.0. Inner margins diverging strongly behind when viewed from above. Antennae fine with very long, fine setae, many of the setae being several times longer than diameter of flagellum. Third segment of maxillary palp somewhat expanded distally. Lacinia (fig. 35) with apex extended laterally at the tip and bearing a few, distinct, blunt apical teeth. Femora setose; tibiae with many ctenidiobothria especially along inner margin of hind leg where they are arranged in a comb-like fashion as an extension of the tarsal row. Ctenidia well developed, the setal component being very strongly curved towards tip of tarsus. Measurements of hind leg: F: 0.60 mm; T: 1.08 mm; t_1 : 0.392 mm; t_2 : 0.056 mm; t_3 : 0.084 mm; rt: 7.0: 1:1.5; ct: 17,0,0. Fore wing length: 2.9 mm; width: 1.1 mm. Hind border of pterostigma concave. Stigmapophysis conical, large, spiculate. Sc evanescent just before wing margin. R curved parallel to curvature of C before pterostigma. Rs and M fused for a short length. Hind wing length: 2.1 mm; width: 0.8 mm. Rs and M fused for a short length; M arising as a weak vein from the much stronger Rs and at right angles to it. Epiproct (fig. 33) with a pair of broad, shallow, spiculate lobes arising from anterior margin. Hypandrium (fig. 36) very well sclerotized, setose. Phallosome (fig. 34) closed anteriorly and posteriorly and with a median, apically upturned rod bearing a small, dorsal knob about two thirds of the way from base; the rod flanged on either side from a little basad of the knob to the distal end.

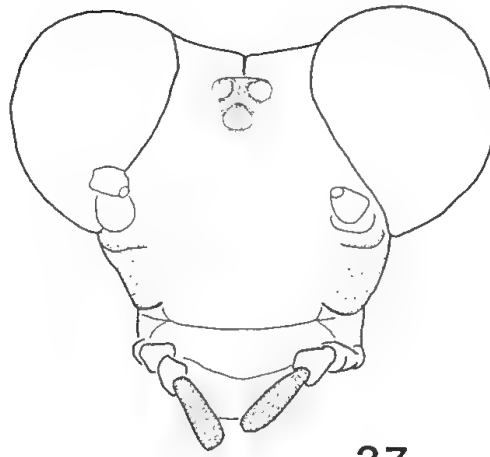
FEMALE. *Coloration* (in alcohol): As in male. Head (fig. 38). Abdomen entirely pale.

Morphology: Length of body: 2.3 mm. Median epicranial suture distinct; anterior arms difficult to see. Vertex straighter than in male with little indication of median groove. Epistomial suture indistinct. Head not narrowing anteriorly as in male. Lengths of antennal segments: f_1 : 0.74 mm; f_2 : 0.66 mm. Eyes smaller than in male. IO/D (Badonnel): 1.5. PO: 0.91. Inner margins of eyes diverging strongly posteriorly when viewed from above. Antennal setae shorter than in male, mostly only a little longer than diameter of flagellum. Lacinia as in male. Measurement of hind leg: F: 0.64 mm; T: 1.16 mm; t_1 : 0.44 mm; t_2 : 0.084 mm; t_3 : 0.084 mm; rt: 5.2:1:1; ct: 19,0,0. Fore and hind wing similar to male. Epiproct simple, rounded behind, setose in basal half; a row of four strong setae across middle and three short, but stout setae near middle of posterior margin. Paraproct with large circular field of trichobothria in which two setae in the middle are without distinct "rosettes". Subgenital plate (fig. 41). Sclerites of ninth sternite at entrance to spermatheca (fig. 40). Gonapophyses (fig. 39); dorsal valve unusual in having fine spicules along its ventral margin.

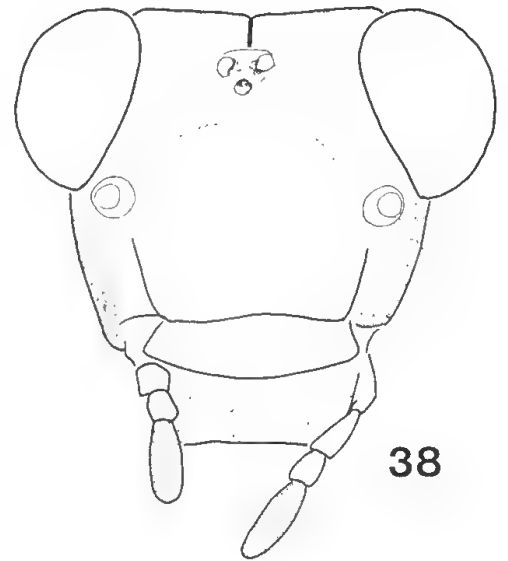
MATERIAL EXAMINED. SOLOMON ISLANDS. GUADALCANAL: 7 ♂ (including holotype), 7 ♀ (including allotype), 18 nymphs, ex *Araucaria excelsa*, Mt. Austen, 7.ix.1975 (I. W. B. Thornton); 1 ♀, Botanic Gardens, Honiara, 19.ix.1975 (C. N. Smithers and I. W. B. Thornton); 1 ♀, Mt. Austen, 2.ix.1975 (I. W. B. Thornton) (AM); 2 ♂, 1 ♀, 2 nymphs, ex *Pinus caribea*, Mt. Austen, 7.ix.1975 (I. W. B. Thornton) (Bishop Mus.).



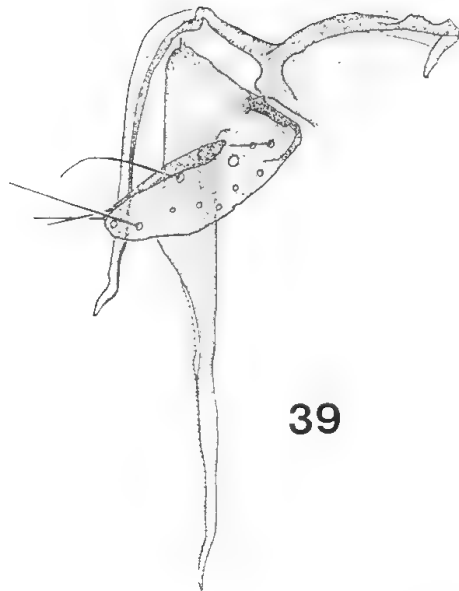
Figs. 32-36. *Phlotodes gregarius* sp. n. ♂. 32. Forewing; 33. Epiproct; 34. Phallosome; 35. Lacinia; 36. Hypandrium.



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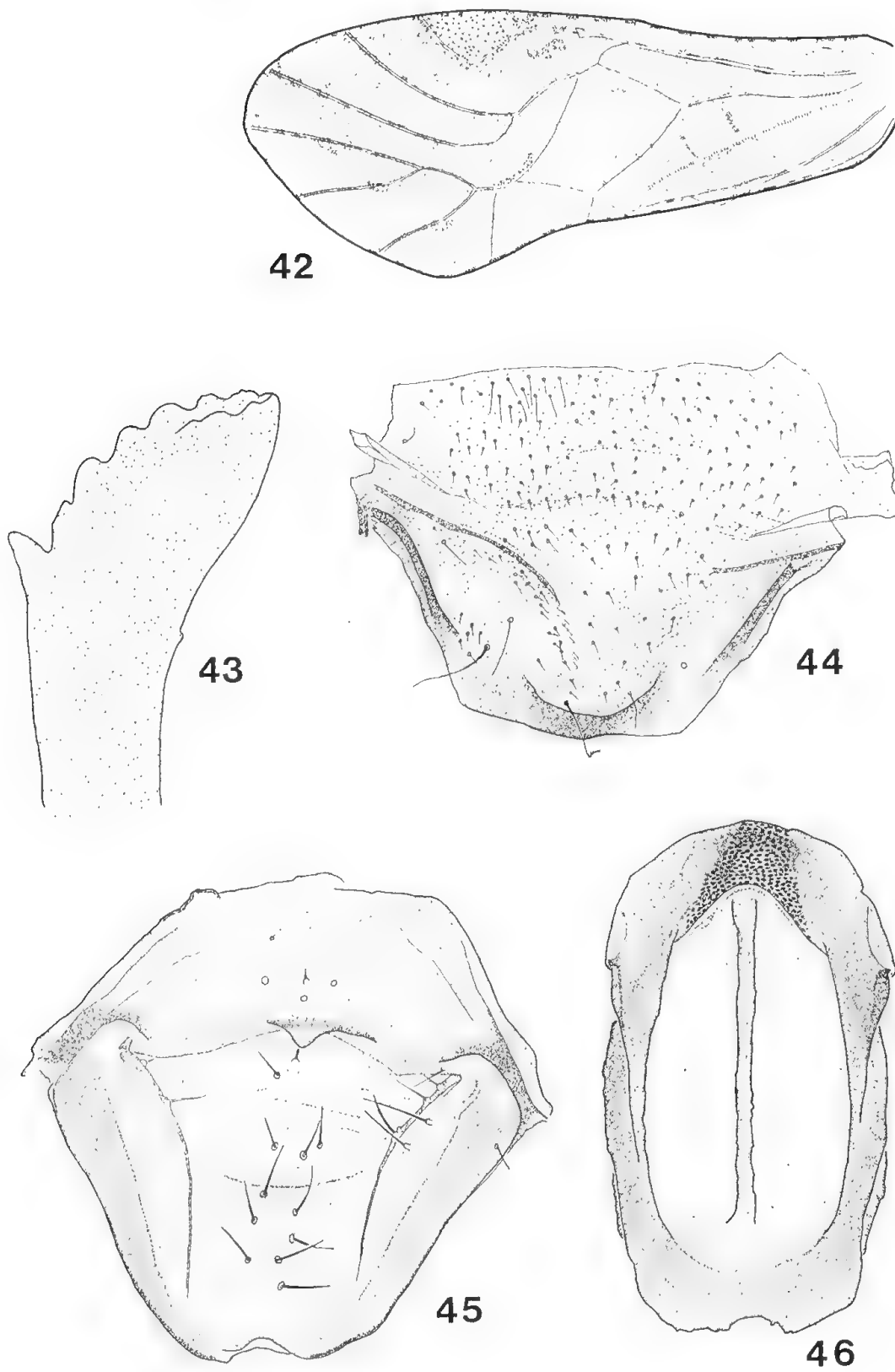


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Figs. 37-41. *Phlotodes gregarius* sp. n. 37. Head ♂; 38. Head ♀; 39. Gonapophyses ♀; 40. Spermathecal entrance; 41. Subgenital plate.



Figs. 42-46 *Phlotodes megops* sp. n. ♂. 42. Forewing; 43. Lacinia; 44. Hypandrium; 45. Epiproct; 46. Phallosome.

NGGELA ISLAND: 2♀, Tulagi, c. 100 m, 5.ix.1975 (I. W. B. Thornton). SAN CHRISTOBAL: 2♂, 4♀, Pamua, 16.ix.1975 (C. N. Smithers and I. W. B. Thornton). NEW GEORGIA: 3♀, 1 nymph, near Ilemi, Viru Harbour, 23.ix.1975 (C. N. Smithers and I. W. B. Thornton) (AM).

Holotype, allotype and paratypes in the Australian Museum; paratypes in the B.P. Bishop Museum. Nymphal material is not designated as paratypes.

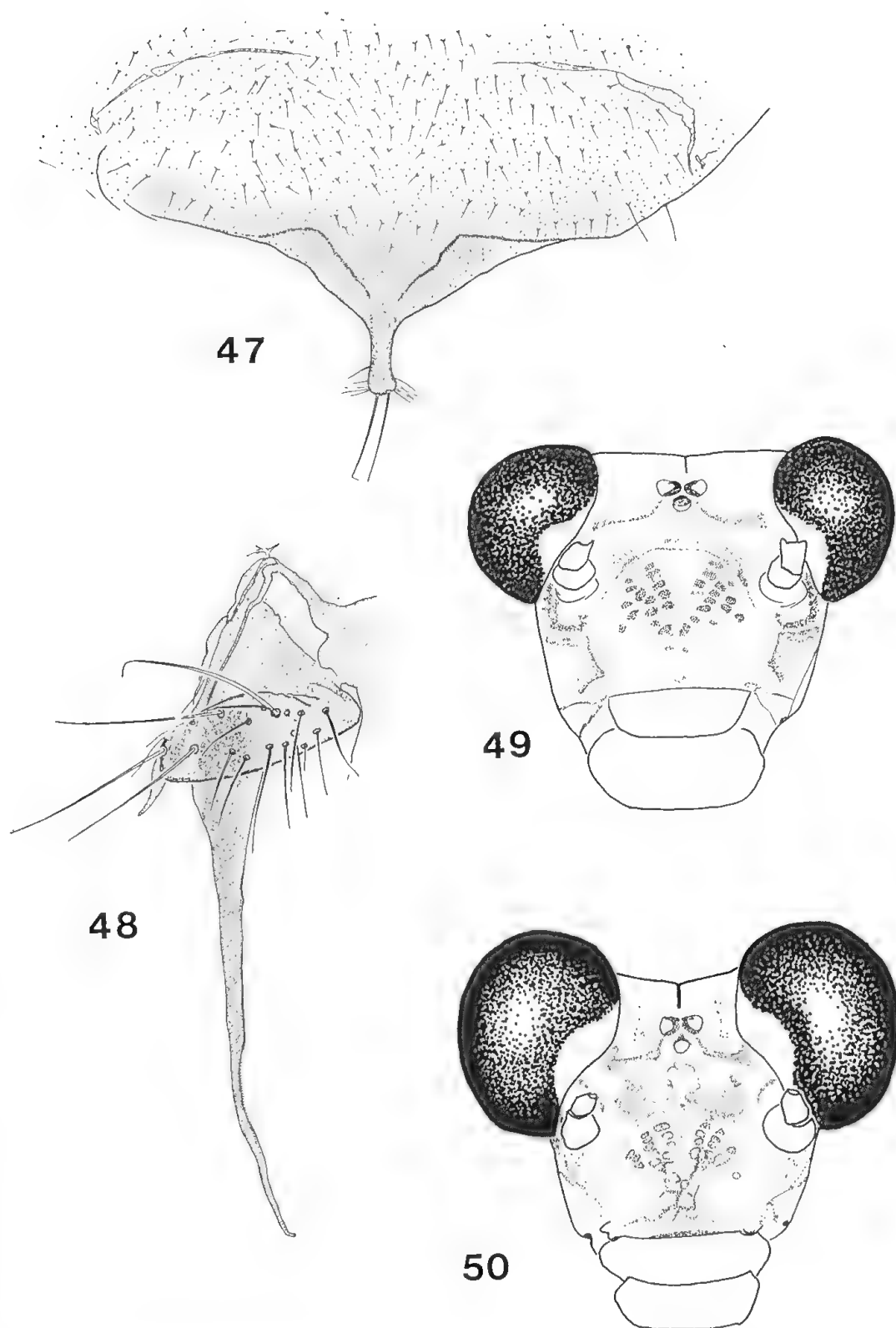
***Phlotodes megops* sp. n.**

MALE. *Coloration* (in alcohol): Head very pale brownish yellow with sparse brown markings (fig. 49). Labrum pale. Genae pale with a small brown mark adjacent to antennal socket. Antennae very pale brownish yellow. Eyes black, a small area adjacent to antenna base not pigmented. Ocelli centripetally margined in black so that they stand out conspicuously against the unusually pale head. Maxillary palp pale, fourth segment pale brown. Thorax dorsally very pale, almost colourless, except for the pale brown anterior section of antedorsum of mesothorax; pleura pale. Coxae colourless. Femora very pale brown with three slightly darker bands. Tibiae pale brown, distal apices a little darker. First tarsal segment pale, second and third segments brown. Fore wings (fig. 42) hyaline with complex pattern of brown marks as usual in the genus. Hind wings hyaline, veins pale brown. Abdomen pale with some dark marks laterally near base and sides of sixth segment with irregular purplish colour due to subcutaneous pigments. Terminal structures pale.

Morphology: Length of body: 3.2 mm. Median epicranial suture distinct, short. Vertex lower in middle. Frons deep. Lengths of first flagellar segment: f_1 : 1.52 mm. Antennae very long and fine, many setae several times as long as flagellar diameter. Eyes very large. IO/D (Badonnel): 0.64; PO: 1.0. Ocellar tubercle well developed. Ocelli large, small setae between facets. Lacinia (fig. 43) outwardly curved at apex, inner major tooth reduced, not much larger than the teeth of the outer part of the apex. Measurements of hind leg: F: 0.92 mm; T: 1.84 mm; t_1 : 0.66 mm; t_2 : 0.098 mm; t_3 : 0.126 mm; rt: 6.8:1:1.3; ct: 26, 1, 1. Hind tibia slightly curved, narrower at proximal end. First tarsal segment with dense clothing of strong setae, second and third segments almost bare except for ctenidiobothria. Fore wing (fig. 42) with costal margin somewhat incurved between base and proximal end of pterostigma. Rs and M fused for a short length. Distal section of Cu_{1a} not as well developed as other sections. A narrow "pocket" present in the wing membrane adjacent to 1A. Fore wing length: 4.5 mm; width: 1.8 mm. Hind wing length: 3.3 mm; width: 1.3 mm. Hypandrium well sclerotized with strongly developed hind margin. Epiproct (fig. 45) with thickened lobe overlying ninth tergite, the lobe being slightly emarginate. Phallosome (fig. 46) closed at both ends, the rim very well developed and broad posteriorly; a narrow median rod present.

FEMALE. *Coloration* (in alcohol): As in male (allotype specimen a little paler than paratypes, probably more recently moulted). Eyes pigmented as in male.

Morphology: Length of body: 3.0 mm. Median epicranial suture distinct, short. Antennae long and fine, setose, setae not as long as in male. Length of first flagellar segment: f_1 : 1.2 mm. Eyes large for a female but not as large as in male. IO/D (Badonnel): 1.3; PO: 0.93. Ocelli large, anterior ocellus a little smaller than lateral ocelli. Inner tooth of lacinia larger than in male. Measurements of hind leg: F: 0.84 mm; T: 1.72 mm; t_1 : 0.62 mm; t_2 : 0.098 mm; t_3 : 0.112 mm; rt: 6.4:1:1.1; ct: 26, 1, 1. Fore wing length: 4.6 mm; width: 1.9 mm. Epiproct simple, setose with a group of isolated setae in central area of epiproct. Subgenital plate (fig. 47) with long terminal setae and a large group of short setae at end of posterior extension of plate. Gonapophyses (fig. 48) with small, spindle shaped external valve; ventral valves fairly short.



Figs. 47-50. *Phlotodes megops* sp. n. 47. Subgenital plate ♀; 48. Gonapophyses ♀; 49. Head ♀; 50. Head ♂.

MATERIAL EXAMINED: BOUGAINVILLE: 1 ♂ (holotype), S. side saddle, W. Mt. Negrohead, near Panguna, 900 m. 10.ix.1975 (C. N. Smithers and I. W. B. Thornton); 1 ♀ (allotype) Valley between Sugarloaf and Negrohead, 300 m., Pihei River, ex *Casuarina* sp., 11.ix.1975 (C. N. Smithers and I. W. B. Thornton). 2 ♂, 2 ♀, as holotype, 12.ix.1975 (C. N. Smithers and I. W. B. Thornton).

Holotype and allotype in the Australian Museum.

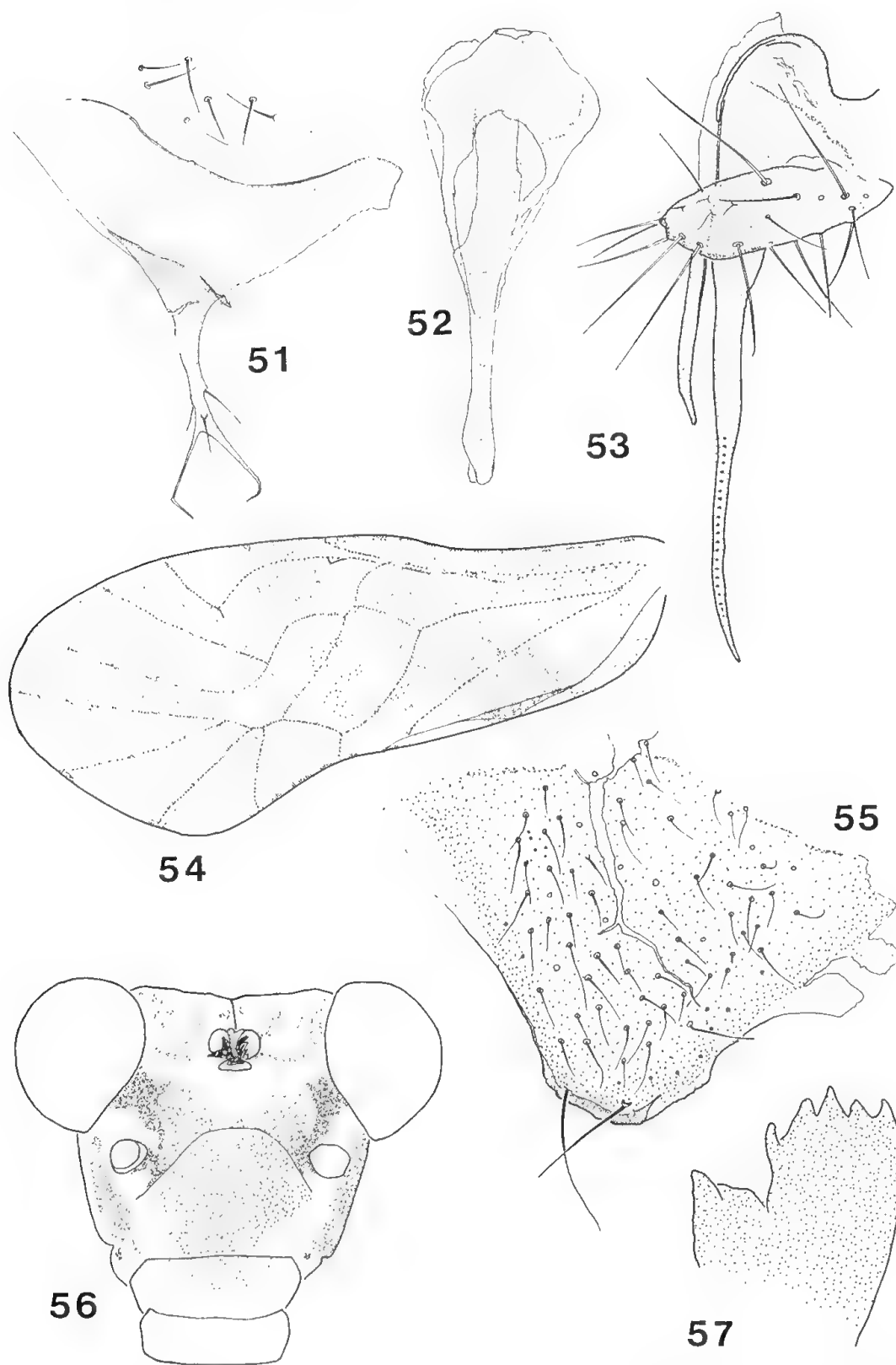
***Phlotodes anomalus* sp. n.**

MALE. *Coloration* (in alcohol): Head very pale on vertex, but with pattern in various shades of brown anterior to vertex. Postclypeal striations distinct, very dark brown. Ocellar tubercle dark. Genae pale with dark mark in posterior half from eye to mandible, broader below than above. Antennae very pale brownish. Eyes black. Maxillary palp brown, fourth segment not darker than others. Thorax pale above and laterally. Legs pale brown without any banding of femora. Fore wings (fig. 54) hyaline with brown pattern. Hind wings hyaline, veins grey. Abdomen pale with irregular brown markings laterally.

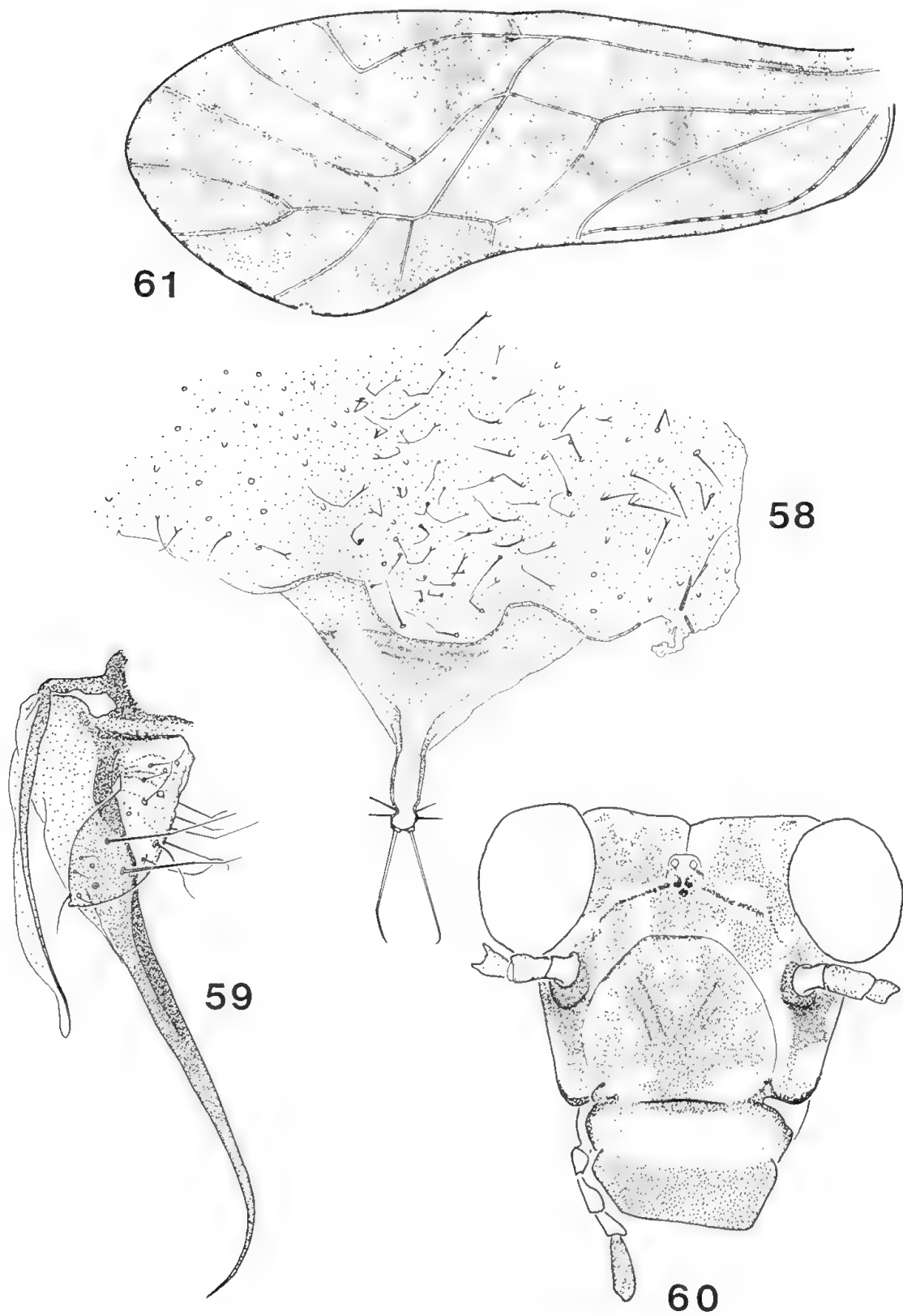
Morphology: Length of body: 2.2 mm. Median epicranial suture distinct as far as ocellar triangle; anterior arms evanescent. Antennae fine with extremely long setae, several times longer than flagellar diameter. IO/D (Badonnel): 0.53; PO: 0.93. Anterior ocellus very small, separated from lateral ocelli by a distance greater than its diameter. Measurements of hind leg: F: 0.57 mm; T: 1.02 mm; t_1 : 0.35 mm; t_2 : 0.062 mm; t_3 : 0.075 mm; rt: 5.4:1:1.2; ct: 17, 1, 1. Hind tibiae narrower at basal end than distally, slightly curved. Fore wing length: 3.0 mm; width: 1.1 mm. Costal area a little broadened near wing base, narrow to base of pterostigma. R_1 (hind margin of pterostigma) very strongly curved so that pterostigma is strongly concave behind. R_s and M fused for a very short length. R_s distad of fusion strongly curved before bifurcation so that $R_4 + 5$ near its base is close to M. M and Cu_1 before branching both curved so that discoidal cell is concave distally and convex basally. Hind wing with R_s and M fusion very short; M very fine. Epiproct simple, rhomboidal with rounded posterior corners, setose, without anterior extension. Hypandrium (fig. 55) well sclerotized in the form of a posteriorly narrowing laterally and posteriorly upturned lobe, setose with two, much stronger, convergent setae near hind margin. Phallosome (fig. 52) unusual; phallic frame very narrow and elongated anteriorly, broadening and closed posteriorly; the frame is curved dorsally towards the broadened, posterior end; a remarkable, broad transverse flap arises about a third of way from hind end.

FEMALE. *Coloration* (in alcohol): Similar to male but with a few spots on pale vertex in addition to other head pattern (fig. 56); postclypeal stripes not pronounced but postclypeus dark brown, similar to postclypeus of male.

Morphology: Length of body: 2.7 mm. Median epicranial suture distinct to ocellar triangle. Frons deep. Antennae fine but setae only about twice as long as flagellar diameter. Length of first flagellar segment: f_1 : 0.8 mm. Eyes large. IO/D (Badonnel): 1.1; PO: 1.2. Ocelli as in male but anterior ocellus very small. Measurements of hind leg: F: 0.62 mm; T: 1.17 mm; t_1 : 0.42 mm; t_2 : 0.052 mm; t_3 : 0.075 mm; rt: 8:1:1.4; ct: 18, 1, 1. Fore and hind wing similar to that of male. Fore wing length: 3.2 mm; width: 1.3 mm. Epiproct broadbased, with a row of four setae across middle, the outer setae very long. Subgenital plate (fig. 51) with exceptionally well developed, strongly diverging setae at end of posterior lobe as well as two unusually strong preapical setae. Gonapophyses (fig. 53) with fairly long ventral valve; external valve spindle shaped with some unusually long setae.



Figs. 51-57. *Phlotodes anomalus* sp. n. 51. Subgenital plate ♀; 52. Phallosome ♂; 53. Gonapophyses ♀; 54. Forewing; 55. Hypandrium; 56. Head ♀; 57. Lacinia.



Figs. 58-61. *Phlotodes platyvalvula* sp. n. ♀. 58. Subgenital plate; 59. Gonapophyses; 60. Head; 61. Forewing.

MATERIAL EXAMINED. SOLOMON ISLANDS. NEW GEORGIA: 1 ♂ (holotype), Tetemara Village, Viru Harbour, 23.ix.1975 (C. N. Smithers and I. W. B. Thornton); MALAITA: 1 ♀ (allotype), Kokomadama, 350 m, 20.ix.1975 (C. N. Smithers and I. W. B. Thornton).

Holotype, allotype and paratypes in the Australian Museum.

DISCUSSION AND COMPARISONS OF SPECIES OF *PHLOTODES* FROM THE SOLOMONS

Phlotodes preclarus is the only species from the Solomons in which the central area of wing membrane is hyaline and stands out in strong contrast to the rest of the wing. *Ph. australis* is the only Solomon species in which the facial pattern includes strong postclypeal stripes. The distinct differences in head pattern of the remaining three species permit easy identification of females and the differences in proportions of the subgenital plates are clear. In males facial pattern and form of the phallosome are distinctly different. In *Ph. gregarius* and *Ph. megops* the phallosome consists of an ovoid ring with a longitudinal median bar whereas in *Ph. anomalus* it is extremely narrow anteriorly, broadened posteriorly with median fusion of the external parameres at their posterior extremity. The phallosome bears a peculiar transverse flap. In *Ph. megops* the phallic frame is broad and well developed with a narrow median rod whereas in *Ph. gregarius* it is a narrow irregular, ring-like structure with a broad, median, longitudinal strap.

MYOPSOCIDAE FROM THE NEW HEBRIDES

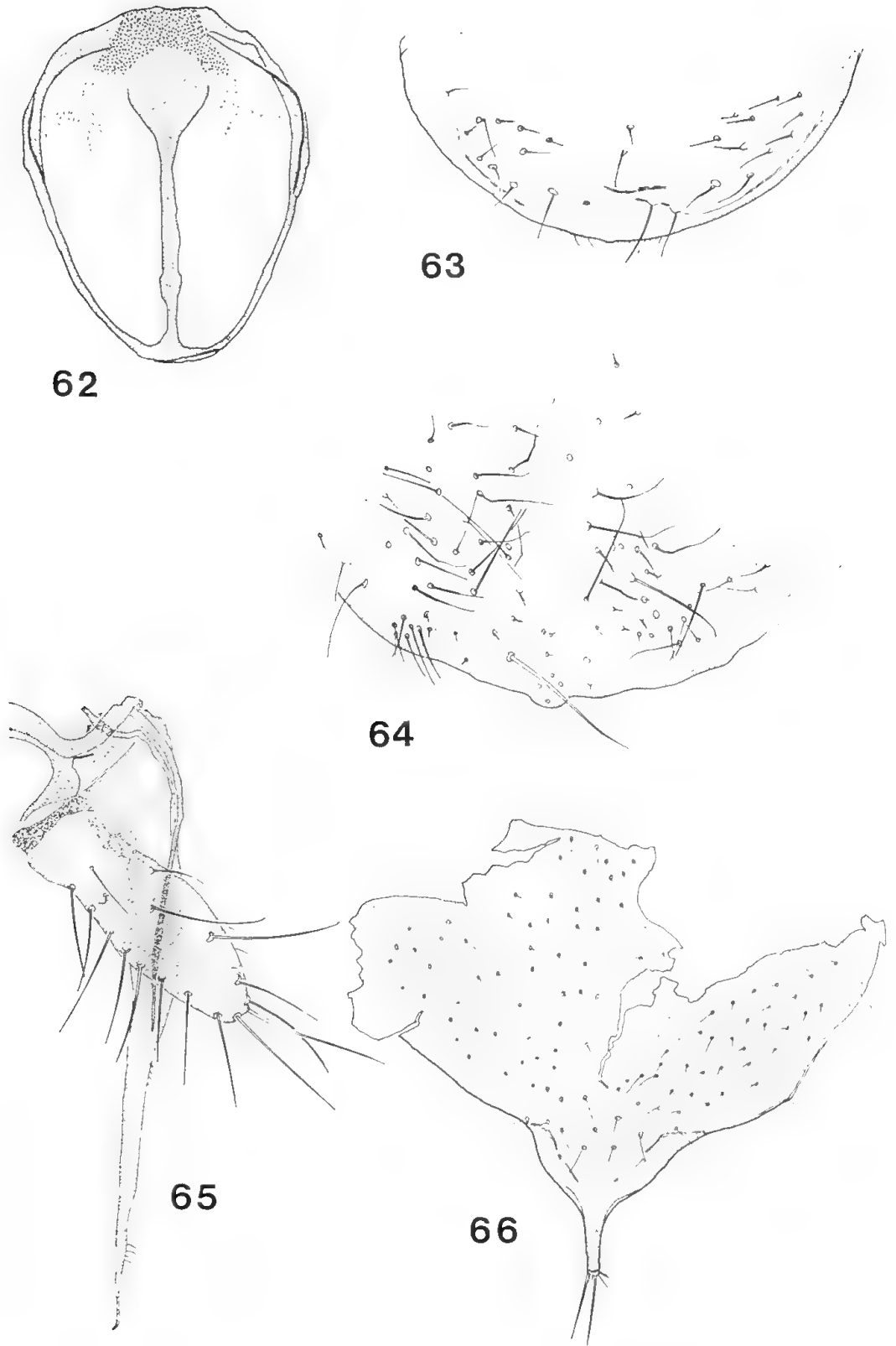
KEY TO SPECIES OF *PHLOTODES* FROM NEW HEBRIDES

1. Hind femur pale with two dark transverse bands in distal third *platyvalvula*
Hind femur dark in basal half, pale in distal half or entirely brown 2
2. ♂epiproct with raised, transverse rugose ridge. ♀ posterior lobe of subgenital plate with two smaller subapical setae and two, usual, larger apical setae .. *sagitta*
♂epiproct with pair of curved, pointed, anteriorly-directed processes which may overlay the ninth tergite. ♀ posterior lobe of subgenital plate with four small setae arising near the bases of the two, usual, larger apical setae .. *hoskinsi*

Phlotodes platyvalvula sp. n.

FEMALE. *Coloration* (in alcohol): Head (fig. 60) pale brown with darker brown markings; some of the converging lines on the postclypeus are broad and laterally fused forming a V-shaped mark. Scape, pedicel and flagellum pale brown. Genae brown below level of antenna bases but pale above mandible. Eyes black. Maxillary palp pale brown with darker fourth segment. Antedorsum dark brown with pale median line; dorsal lobes dark brown anteriorly, mottled in various shades of brown in posterior half; sutures pale. Fore femur pale, with double brown band in distal third; tibia pale with dark tip; first tarsal segment pale, second and third segments dark brown. Hind leg similar to fore leg but femur has only one band near distal end. Fore wings (fig. 61) with complex pattern in shades of brown, on hyaline background. Hind wings hyaline with brown veins, a small brown patch in costal area near wing base.

Morphology: Length of body: 2.9 mm. Median epicranial suture distinct. Anterior arms evanescent. Length of first flagellar segment: f_1 : 0.88 mm. Eyes moderately large,



Figs. 62-64. *Phlotodes platyvalvula* sp. n. ♂. 62. Phallosome; 63. Epiproct; 64. Hypandrium.
Figs. 65-66. *Phlotodes hoskinsi* sp. n. ♀; 65. Gonapophyses; 66. Subgenital plate.

reaching vertex. IO (Badonnel): 1.3; PO: 0.83. Measurements of hind leg: F: 0.68 mm; T: 1.24 mm; t_1 : 0.49 mm; t_2 : 0.07 mm; t_3 : 0.10 mm; rt: 7.1:1:1.1; ct: 21, 1, 1. Fore wing length: 3.4 mm; width: 1.3 mm. Epiproct and paraproct similar to *P. brunneigena*. Subgenital plate (fig. 58) with fairly short lobe terminating in two strong setae, not set on tubercles and with four, laterally directed, small, preapical setae. Gonapophyses (fig. 59).

MALE. *Coloration* (in alcohol). As in female.

Morphology: Length of body: 2.8 mm. Median epicranial suture distinct. Length of first flagellar segment: f_1 : 1.28 mm. Antennae fine, strongly setose, some setae twice as long as flagellar thickness. Eyes large. IO/D (Badonnel): 0.64; PO: 0.94. Measurements of hind leg: F: 0.80 mm; T: 1.52 mm; t_1 : 0.55 mm; t_2 : 0.07 mm; t_3 : 0.09 mm; rt: 6.1:1:1.3; ct: 24, 1, 1. Hind femur fairly short and stout; tibia slightly curved and a little wider at distal end than proximally. Fore wing length: 3.9 mm; width: 1.4 mm; venation similar to female. Hind wing length: 2.8 mm.; width: 1.0 mm. M and Cu_2 very fine. Epiproct (fig. 63). Paraproct well sclerotized, with a large, ovoid field of trichobothria and a broad, posterodorsally directed posterior lobe; very similar to the paraproct of *Ph. sagitta* (fig. 75). Phallosome (fig. 62). Hypandrium (fig. 64).

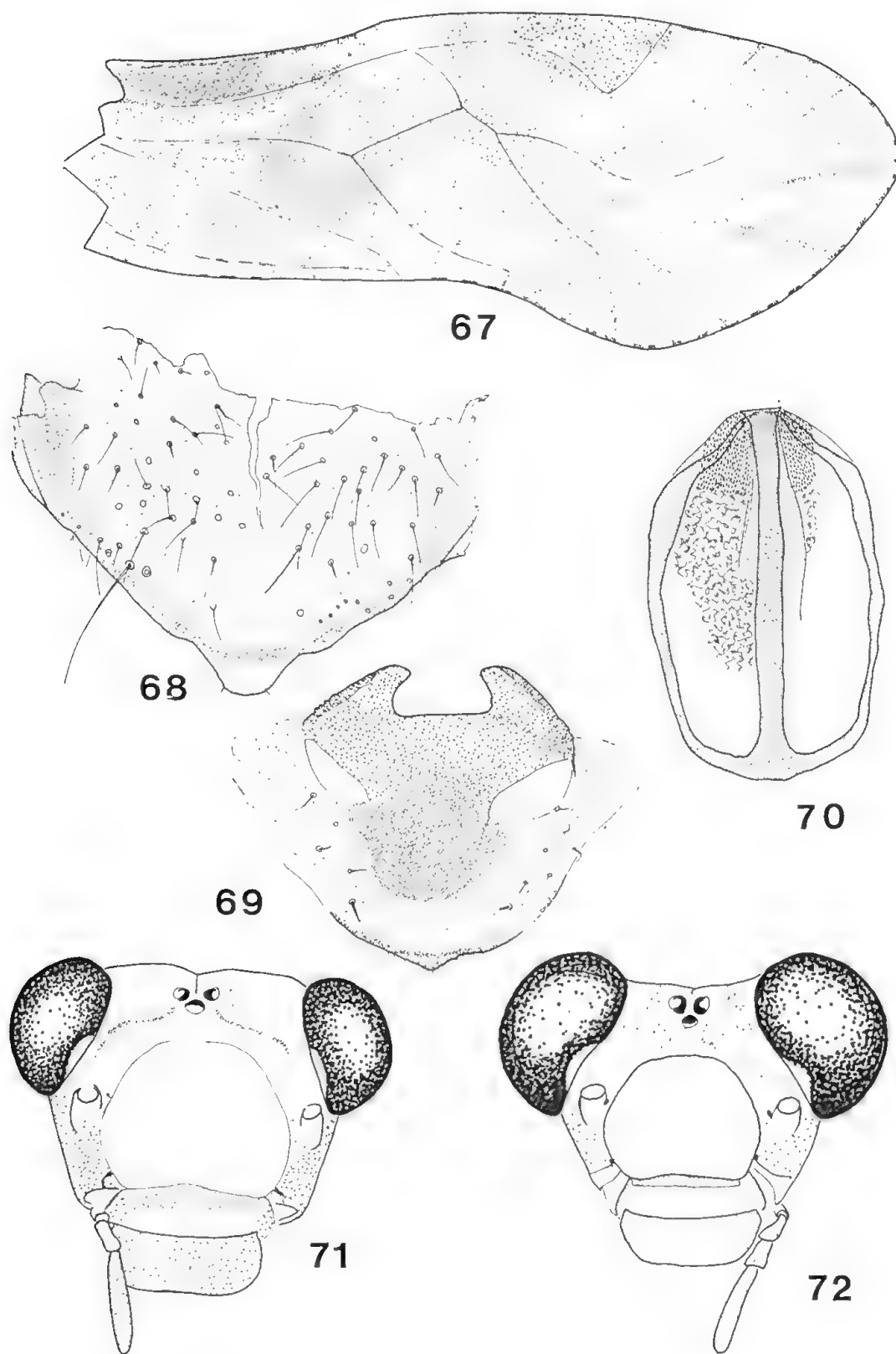
MATERIAL EXAMINED. NEW HEBRIDES. TANNA ISLAND: 1 ♀ (holotype), 2 ♂ (including allotype), Bethel, 24.ix.1976 (C. N. Smithers & I. W. B. Thornton); 1 ♀, British Agent's Garden, Isangel, 25.ix.1976 (C. N. Smithers and I. W. B. Thornton). ERROMANGA: 1 ♀, Dillon's Bay, 27.ix.1976 (C. N. Smithers & I. W. B. Thornton). EFATE: 1 ♀, 4 km NW Forari, 22.ix.1976 (C. N. Smithers & I. W. B. Thornton), 5 ♀, 2 km NW Klom, 23.ix.1976 (C. N. Smithers & I. W. B. Thornton).

Holotype, allotype and paratypes in the Australian Museum. Known also from Bismarcks.

***Phlotodes hoskinsi* sp. n.**

MALE. *Coloration* (in alcohol): Head (fig. 72, paratype), very pale with brown markings. A very faint mark on vertex on either side of the median epicranial suture reaching forward to the ocellar triangle. Faint browning between ocellar triangle and eyes. A brown line from in front of ocellar triangle curving to antenna base on each side. Anterior half of postclypeus with convergent rows of brown spots. Genae dark brown. Anteclypeus and labrum dark brown. Eyes black with indications of a grey top and suggestion of a median, transverse brown band. Antennae pale brown, each flagellar segment with a pale tip making segmentation conspicuous. Ocelli bordered centripetally in black. Maxillary palps entirely dark brown; mesothoracic notum pale, antedorsum dark brown, lateral lobes with mottled brown markings. Pleura dark brown below wing base, otherwise pale. Coxae dark brown. Fore and middle femora dark brown with narrow preapical pale band; hind femora entirely dark brown. Tibiae brown in basal half, paler in distal half except for brown tips. Basal tarsal segments pale, second and third segments dark. Fore wing (fig. 67) pale with complex pattern in various shades of brown; particularly noteworthy is the very dark brown coloration of the costal area near the base of the wing. Hind wing hyaline, dark in costal area near wing base and a few small dark spots on costal margin just basad of R_2+3 ; veins brown, anterior veins darker than those in posterior part of wing. Abdomen pale, well sclerotized terminal structures dark brown.

Morphology: Length of body 2.4 mm. Epicranium curving down to a furrow in which lies conspicuous epicranial suture. Frons deep, i.e. epistominal suture distant from ocellar triangle. Length of flagellar segments: f_1 : 0.88 mm; f_2 : 0.64 mm. Antennae with long, erect setae. Eyes large. IO/D (Badonnel): 0.71; PO: 1.1. Small setae between facets. Eyes diverging strongly behind when viewed from above. Ocelli large. Gena with a row of



Figs. 67-72. *Phlotodes hoskinsi* sp. n. 67. Forewing; 68. Hypandrium♂; 69. Epiproct♂; 70. Phallosome♂; 71. Head♀; 72. Head♂.

strong, short, conspicuous setae below antenna base. Measurements of hind leg: F: 0.68 mm; T: 1.24 mm; t_1 : 0.504 mm; t_2 : 0.070 mm; t_3 : 0.098 mm; rt: 7:1:1.2; ct: 19, 0, 0. Hind tibiae slightly curved. Fore wing length: 2.9 mm; width: 1.0 mm. R_1 strongly curved before apex of pterostigma. R_s and M and Cu_{1a} and M fused for a length. Hind wing length: 2.2 mm, width: 0.8 mm. Epiproct (fig. 69) with two hood shaped lobes, the apices of which tend to overlie the ninth tergite. Hypandrium (fig. 68). Phallosome (fig. 70).

FEMALE. *Coloration* (in alcohol): Head pale, as in male, with pattern in pale brown (paratype, fig. 71). Eyes marked as in male. Body, legs and wings as in male.

Morphology: Length of body: 3.1 mm. Median epicranial suture distinct, anterior arms evanescent. Genae with row of short, stout setae below antenna base. Length of flagellar segments: f_1 : 0.88 mm; f_2 : 0.72 mm. Antennae with fewer and shorter setae than in male. Eyes moderately large. IO/D (Badonnel): 1.3; PO: 0.86. Small setae between facets. Eyes strongly divergent behind. Ocelli large. Measurements of hind leg: F: 0.76 mm; T: 1.40 mm; t_1 : 0.504 mm; t_2 : 0.070 mm; t_3 : 0.098 mm; rt: 1.7:1:1.2; ct: 21, 0, 0. Fore wing length: 3.4 mm; width: 1.2 mm. Venation as in male. Hind wing length: 2.5 mm; width: 0.9 mm. Epiproct almost triangular with rounded posterior angle bearing a transverse row of small setae across middle, two very large lateral setae nearer apex, three almost at apex and a marginal row of small setae. Subgenital plate (fig. 66). Gonapophyses (fig. 65).

MATERIAL EXAMINED. NEW HEBRIDES. AOBA ISLAND: 2♂ (including holotype), 3♀ (including allotype), Lolawai, 18.ix.1976 (C. N. Smithers & I. W. B. Thornton); 2♂, 2♀, Naruga, 19.ix.1976 (C. N. Smithers & I. W. B. Thornton); 1♂, 1 nymph, Targil, 21.ix.1976 (C. N. Smithers & I. W. B. Thornton); 1♂, Vureas, 19.ix.1976 (C. N. Smithers & I. W. B. Thornton). ERROMANGA: 4♀, 3 nymphs, Airstrip, 27.ix.1976 (C. N. Smithers & I. W. B. Thornton). EPI: 1♂, Purumba Village, 14.ix.1976 (C. N. Smithers & I. W. B. Thornton); 1♂, Lamén Bay, 15.ix.1976 (C. N. Smithers & I. W. B. Thornton). EFATE: 1♂, 3♀, Rentapoa, 22.ix.1976 (C. N. Smithers & I. W. B. Thornton). ESPIRITU SANTO: 1♂, Narango, 16.ix.1976 (C. N. Smithers & I. W. B. Thornton). TANNA ISLAND: 1♀, 2 km SE Bethel, 26.ix.1976 (C. N. Smithers & I. W. B. Thornton).

Holotype, allotype and paratypes (excluding nymphs) in Australian Museum.

***Phlotodes sagitta* sp. n.**

MALE. *Coloration* (in alcohol): Head (fig. 78) pale brown, marked in various shades of darker brown; hind part of occipital region (not visible in illustration) very dark next to median suture. Median epicranial suture very dark. Genae irregularly marked in brown. Scape and pedicel brown, flagellar segments pale brown except for darker brown at each end with a pale band at junctions of segments, the flagellar segments are thus very clearly defined. Eyes black. Maxillary palp with all segments brown. Antedorsum of mesothorax dark brown, dorsum otherwise pale, sparsely mottled with brown. Fore and middle femora pale at base, dark in middle section, with a pale distal band and dark band at end; tibiae pale with almost black distal tip; first tarsal segment pale, second and third segments almost black. Hind legs similar to those of meso- and metathorax but femur pale in basal half becoming dark brown in distal half, not banded. Fore wing (fig. 73) with mottled pattern as usual in the genus. Hind wing hyaline, a few dark marks along anterior margin between ends of R_1 and R_2+3 .

Morphology: Length of body: 2.7 mm. Median epicranial suture distinct; anterior arms evanescent. Head with usual clothing of fine setae but with scattered, longer setae; a few short setae on genae below eyes. Length of first flagellar segment: f_1 : 1.24 mm. First

flagellar segment somewhat curved. Antennae with setae up to three times as long as segment diameter. IO/D (Badonnel): 0.70; PO: 1.0. Eyes large, reaching above level of vertex, upper margin strongly diverging behind. Small setae between facets. Lacinia (fig. 74). Measurements of hind leg: F: 0.76 mm; T: 1.48 mm; t_1 : 0.54 mm; t_2 : 0.07 mm; t_3 : 0.098 mm; rt: 7.7:1:1.4; ct: 21, 0, 0. Tibia slightly curved. Fore wing length: 4.0 mm width: 1.4 mm. Basal section of Sc strongly developed, disappearing about one third of distance from pterostigma. Stigmapophysis flattened, not strongly protruding. Hind margin of pterostigma strongly concave, Rs and M and Cu_{1a} and M fused for a length. Hind wing length: 2.8 mm; width: 1.0 mm. Epiproct (fig. 82) well sclerotized with a transverse, spiculate flap across middle. Hypandrium (fig. 76). Phallosome (fig. 77). Paraproct (fig. 75).

FEMALE. *Coloration* (in alcohol): As in male but much darker. Head (fig. 81). Eyes with suggestion of dark banding.

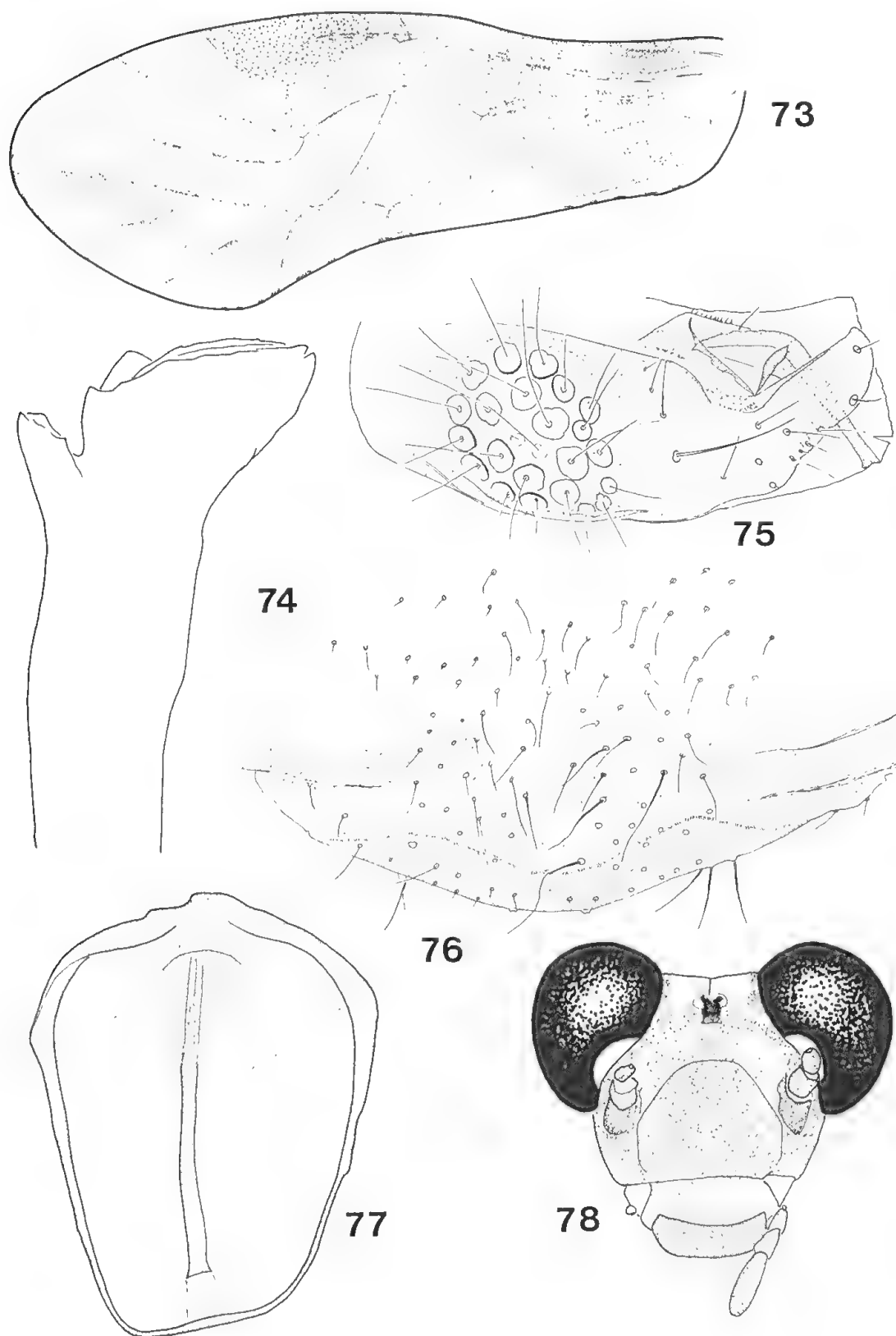
Morphology: Length of body: 3.0 mm. Antennae as in male but with setae relatively shorter. Eyes fairly large, just reaching level of vertex. IO/D (Badonnel): 1.25; PO: 0.9. Upper margins strongly divergent. Second segment of maxillary palp flask-shaped, narrow in basal half, broadened considerably in distal half so that third segment appears to arise from out of mouth of flask. Measurements of hind leg: F: 0.52 mm; T: 1.80 mm; t_1 : 0.68 mm; t_2 : 0.084 mm; t_3 : 0.10 mm; rt: 8:1:1.2; ct: 25, 0, 0. Tibia very slightly curved. Fore wing length: 4.6 mm; width: 1.7 mm. Basal section of Sc fairly well developed running about 1/8th way to pterostigma before becoming evanescent in costal cell. Hind margin of pterostigma strongly concave, Rs and M and Cu_1 and M fused for a length. Hind wing length: 3.6 mm; width: 1.3 mm. Epiproct tapering posteriorly, truncate. Subgenital plate (fig. 79) with fairly long posterior extension, two strong apical setae and a pair of shorter preapical setae. Gonapophyses (fig. 80) with strongly chitinized dorsal valve in which the basal part is strongly ridged dorsally; ventral valve fine, apically curved downwards; external valve fairly broad with some of its setae arranged in a curved row parallel to its posterior border.

MATERIAL EXAMINED. NEW HEBRIDES. ERROMANGA: 2 ♂ (including holotype), Airstrip, 29.ix.1976 (C. N. Smithers & I. W. B. Thornton); 3 ♂, Dillon's Bay, 27.ix.1976 (C. N. Smithers & I. W. B. Thornton). EPI: 1 ♀ (allotype), Lamén Bay, 15.ix.1976 (C. N. Smithers & I. W. B. Thornton).

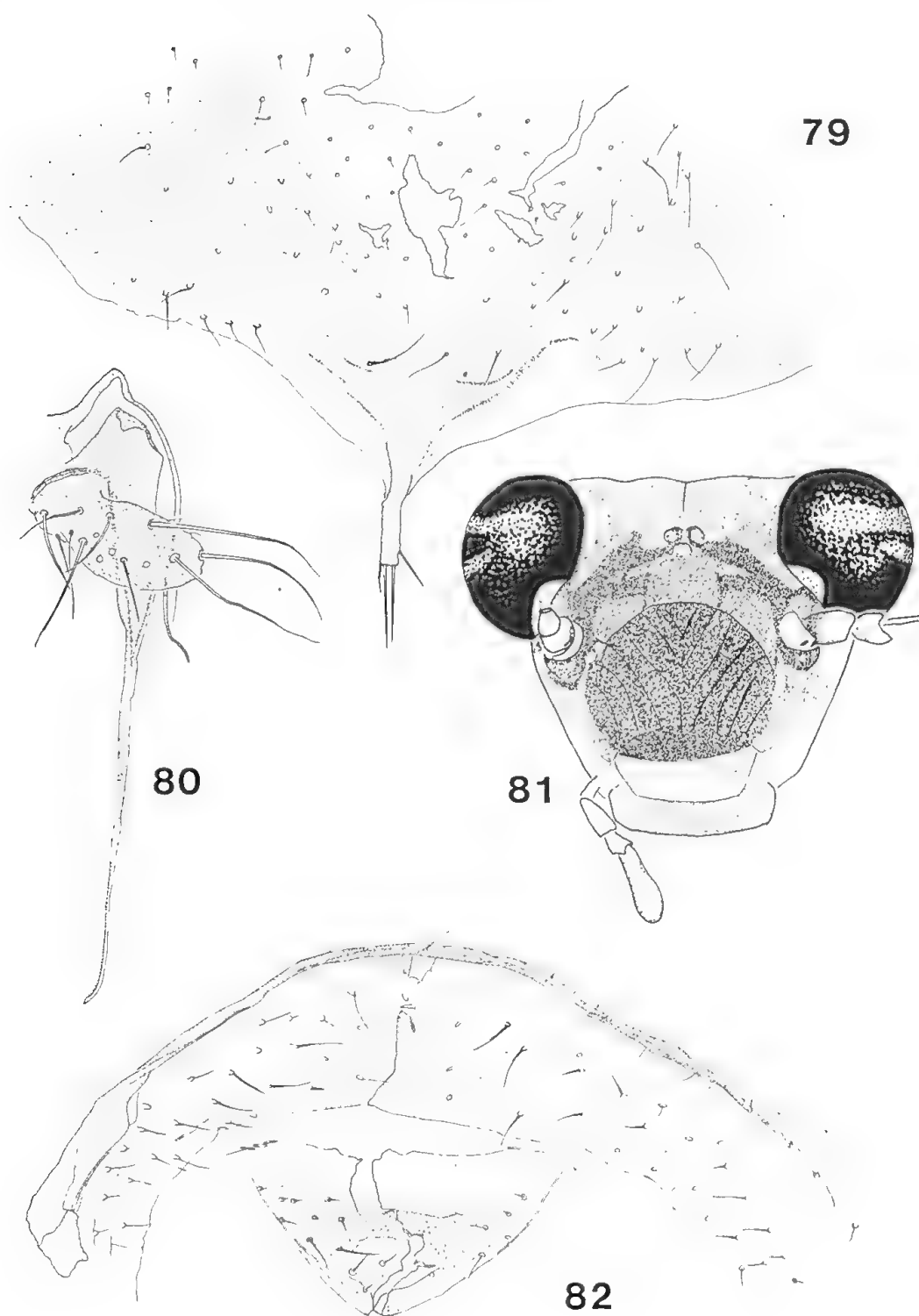
Holotype, allotype and paratypes in the Australian Museum.

DISCUSSION AND COMPARISONS OF SPECIES OF *PHLOTODES* FROM THE NEW HEBRIDES

Of the three species of *Phlotodes* now known from the New Hebrides only *Ph. hoskinsi* has a postclypeus without pattern; both *Ph. sagitta* and *Ph. platyvalvula* have dark colouring on the postclypeus. The males of *Ph. sagitta* differ from those of *Ph. hoskinsi* in having a transverse, raised ridge across the epiproct, in *Ph. hoskinsi* there is a pair of curved, forwardly-directed processes. In *Ph. sagitta* females there are two preapical setae on the posterior lobe whereas in *Ph. hoskinsi* there are four. There are also differences in the complex wing pattern discernible by reference to the figures in this paper.



Figs. 73-78. *Phlotodes sagitta* sp. n. ♂ 73. Forewing; 74. Lacinina; 75. Paraproct; 76. Hypandrium; 77. Phallosome; 78. Head.



Figs. 79-82. *Phlotodes sagitta* sp. n. 79. Subgenital plate♀; 80. Gonapophyses♀; 81. Head♀; 82. Ninth tergite and epiproct.♂

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This paper forms part of the results of a study of the Psocoptera of the Melanesian arcs and we would like to record our thanks to the Australian Research Grants Committee for continuing financial support of the project.

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RECORDS OF THE AUSTRALIAN MUSEUM

A CATALOGUE OF THE ASCIDIAN TYPE-SPECIMENS
IN THE AUSTRALIAN MUSEUM

FRANCIS W. E. ROWE AND JANET I. MARSHALL

THE GENUS *PECTICUS* LOEW FROM AUSTRALIA,
NEW GUINEA AND THE BISMARCK AND SOLOMON
ARCHIPELAGOS
(DIPTERA: STRATIOMYIDAE)

GREG DANIELS

THE CARBONIFEROUS BRACHIOPODS *PODTSHEREMIA PRIMA*
FROM THE U.S.S.R. AND *PODTSHEREMIA AUSTRALIS* FROM
EASTERN AUSTRALIA

DALE MARIE THOMPSON



A CATALOGUE OF THE ASCIDIAN TYPE — SPECIMENS IN THE AUSTRALIAN MUSEUM, SYDNEY

FRANCIS W. E. ROWE AND JANET I. MARSHALL
The Australian Museum, Sydney



SUMMARY

Nearly 400 type-specimens representing 137 currently-recognised species of ascidians are listed. The majority of these species have been described by Patricia Kott and W. A. Herdman, and are from Australian waters.

INTRODUCTION

The ascidian type-collection in the Australian Museum presently comprises about 384 specimens, representing 155 nominal species, of which about 137 are currently recognised. Of the 155 nominal species, 82 have been described by Kott since 1952; 57 were described by Herdman (1899), 6 by Michaelsen (1898, 1900) 3 by Herdman and Riddell (1913), 3 by Kesteven (1909) and 2 each by Hastings (1931) and Brewin (1953, 1956).

Of the currently-recognised species, 123 were collected from around the coasts of Australia, 10 are from the Antarctic and 4 from the South Atlantic. Collections from the Australian coasts appear to include types of at least 60% of the known Australian fauna as recognised by Kott (1974). However, Kott only lists distributions for 71 of the species represented in the Australian Museum collections. Of these, 55 are considered by Kott (1974) to be endemic, mostly with a temperate distribution.

Fifty-two species not discussed by Kott (1974) also appear to be endemic, occurring almost entirely in temperate waters. Kott (1974) considered the Australian fauna to comprise about 200 species of which she dealt with 180 in her paper. Considering the number of species housed in the Australian Museum not considered by Kott, and allowing for new species described since 1974, it can be projected that, at the time of writing, about 250 species of ascidian are known to occur around the coasts of Australia, of which 60% are likely to be endemic.

Without doubt Kott is the most prolific Australian ascidian taxonomist and, therefore, is responsible for most of the descriptions and synonymies. Often, however, particularly prior to 1962, Kott did not designate type-specimens in her descriptions of new species. The type specimens are known to be housed in the Australian Museum (Kott, pers. comm.). Consequently, where only one specimen is recorded and is in this collection, this specimen is considered to be the holotype (Article 73(a) I.C.Z.N.). If several specimens are recorded in the literature, but there is no clear indication that the description has been based on a single specimen, then specimens held in the museum are considered to form a syntype-series. In recent reports, specimens other than that listed by Kott as the holotype are recorded here as paratypes.

With regard to "colonial" and "compound" species, each type specimen is considered as a single entity, regardless of the number of "heads" or "lobes" it may possess, unless originally broken up and separately labelled by the author of the species.

Entries in this catalogue are arranged alphabetically by original species or subspecies name. Where the genus — or the species — name has subsequently changed, the new name is also given, together with a reference to the source of the change.

Australian Museum catalogue numbers are prefaced by the letters "U", "G", "Y" or "Z", "Y" being the current registration letter.

LIST OF SPECIES

- aclara*, *Ascidia* Kott (1952, p. 309, figs 170-171).
Y1648, HOLOTYPE, 5-6 mls E. of Lakes Entrance, Victoria, 38 m, scallop dredge, 13.8.1938, C.S.I.R.O. Fisheries.
- amorphatum*, *Aplidium* Kott (1963, p. 101).
U3918, HOLOTYPE, 38°51'S, 146°55'E, 36 m, scallop dredge, 12.8.1938, C.S.I.R.O. Fisheries.
- anomalum*, *Amaroucium* Herdman (1899, p. 76, pl. Plc III figs 11-16).
U353 (G2107), HOLOTYPE, Port Jackson, New South Wales.
= *Clavelina claviformis* (Herdman) — see Kott, 1957, p. 88.
- antarcticum*, *Sidnyum* Kott (1954, p. 176).
Y1081, HOLOTYPE, near Murray Monolith, MacRobertson Land, 13.2.1931, B.A.N.Z.A.R.E., in 163 m.
= *Aplidium circumvolutum* (Sluiter) — see Kott, 1969, p. 57.
- arenosum*, *Eudistoma* Kott (1957, p. 73, figs 3-4).
Y1284, HOLOTYPE, Mary Cove, Rottnest Island, Western Australia.
- areolata*, *Placentela* Kott (1963, p. 74, fig. 3).
U3925, HOLOTYPE, off Mackay, Queensland, 10 m, Agassiz trawl, 12.7.1939.
Y1316, PARATYPE, locality same as U3925.
- atopogaster*, *Synoicum* Kott (1963, p. 89, fig. 9).
U3927, HOLOTYPE, 28°33.5'S, 113°E, 36 m, (station 122W/48), drift-net, C.S.I.R.O. Fisheries.
- attollens*, *Polycarpa* Herdman (1899, p. 53, pl. Cyn XX, figs 6-8).
U149 (G2086), HOLOTYPE, Port Jackson, New South Wales.
Note: A label, in Herdman's handwriting, lists this specimen as originating from Moreton Bay, Queensland, but the report records Port Jackson.
- australiensis*, *Aplidium* Kott (1963, p. 111, fig. 25).
Y1398, HOLOTYPE, Shoreham, Victoria, A. Tubb 17.9.1936.
U3914, PARATYPE, Western Port, Victoria, May, 1915.
- australiensis*, *Distaplia* Brewin (1953, p. 61, fig. 3).
U3842, HOLOTYPE, south of Tasmania, 43 m.
- australiensis*, *Polyandrocarpa* Kott (1952, p. 249, figs 63-64).
Y796, SYNTYPE, Thompson's Bay, Rottnest Island, Western Australia, reef, just south of the jetty, 16.12.1948.
Y797, SYNTYPE, ? Fremantle, Western Australia, between South Mole and Fish Market jetty, on piles in the cove, 9.1.1949.
Y1570, SYNTYPE, locality same as Y796.
Y1572, SYNTYPE, Hamelin Bay, Western Australia, on jetty piles, 14.1.1949.
Y1573, SYNTYPE, Trigg's Island, Western Australia, undercut of reef on the south side, 27.12.48.
- australis*, *Euherdmania* Kott (1957, p. 103).
Y1165, SYNTYPE, Port Phillip Heads, Victoria, J. F. Wilson.
Y1317, SYNTYPE, locality same as Y1165.

- australis*, *Microcosmus* Herdman (1899, p. 23, pl. Cyn V).
G2060 (3) SYNTYPES, Port Jackson, New South Wales.
- australis*, *Pseudodistoma* Kott (1957, p. 101, fig. 32).
Y919, HOLOTYPE, Parrakeet Bay, Rottnest Island, Western Australia, 14.12.1948.
- australis*, *Stereoclavella* Herdman (1899, p. 6, pl. Clav I figs 1-11).
U132 (G2092), HOLOTYPE, Vaucluse Point, Port Jackson, New South Wales.
= *Podoclavella australis* (Herdman) — see Kott, 1957, p. 93.
- barbaris*, *Styela* Kott (1952, p. 224, figs 25-26).
Y1689, HOLOTYPE, Peel Island, Moreton Bay, Queensland, south side, 3 m.,
3.11.1948.
= *S. orbicularis* Sluiter — see Kott, 1964 p. 139.
- batemani*, *Molgula* Kott (1952, p. 296).
Y789, SYNTYPE, on hull of the 'Warren & Bonthorp' or the piles of Fremantle
Harbour, Western Australia, 31.1.1949, C.S.I.R.O. Fisheries.
Y1884, SYNTYPE, locality same as Y789.
Note: The type locality of this species must be considered to be somewhat doubtful.
- baudinensis*, *Clavelina* Kott (1957, p. 87, figs. 19-21).
Y801, (3), SYNTYPES, Cape Vlamingh, Rottnest Island, Western Australia, 19.11.1951.
Y1118, (3), SYNTYPES, locality same as Y801.
- brevilarvacium*, *Aplidium* Kott (1963, p. 113, fig. 27).
U3926, HOLOTYPE, Sugarloaf Rock, Cape Naturaliste, South-western Australia,
13.1.1949.
Note: Kott's label with the specimens refers to 'paratypes', the text of her report
refers to the colonies as the 'holotype'; there are 7 colonies.
- bridgesi*, *Alloeocarpa* Michaelsen (1900, p. 41, Table 11, fig 19, Table 111, fig. 10),
U154 (G4163), SYNTYPE, Picton Island, South Falkland, Michaelsen, 26.12.92, 3 fms.
- capricornia*, *Polycarpa* Kott (1952, p. 239, fig. 50).
Y1747, HOLOTYPE, Thursday Island, Queensland, 6-9 m, 19.11.48, C.S.I.R.O.
Fisheries.
= *P. longiformis* Tokioka — see Kott 1966, p. 298.
- cataphracta*, *Cynthia* Herdman (1899, p. 31, pl Cyn XI figs 1-7).
U250 (G2066), (3), SYNTYPES, Port Jackson, New South Wales.
= *Pyura cataphracta* (Herdman) — see Kott, 1976, p. 77.
- circulum*, *Polysyncrator* Kott (1962, p. 298, figs 31-32).
Y1489, HOLOTYPE, South of Peel Island, Moreton Bay, Queensland, dredged in
5-10 m, 17.7.1961, W. Stephenson.
U3947, PARATYPE, east of Snipe Island, Moreton Bay, Queensland, 3 m, 12.6.1961.
U3948, PARATYPE, Mackay, Queensland, 10 m, 12.7.1939.
- circumvolutum*, *Synoicum* Kott, (1954, p. 169, fig. 63).
Y1363, SYNTYPE, Atlas Cove, Heard Island, Antarctic, B.A.N.Z.A.R.E.
= *Aplidium irregulare* (Herdman) — see Kott, 1969, p. 50.
- clava*, *Polyclinum* Herdman (1899, p. 77, pl. Pcl I figs. 5-8).
U154, HOLOTYPE, Port Jackson, New South Wales.

claviforme, *Protopolyclinum* Kott (1963, p. 72, fig. 2).

U3920, HOLOTYPE (part) Haystack Beach, near Eden, New South Wales, 50 m, 10.10.1948.

U3919, HOLOTYPE (part), locality same as U3920.

claviformis, *Colella* Herdman (1899, p. 67, pl. Dist III figs 1-15).

U151, (2) SYNTYPES, Port Jackson, New South Wales

U241, SYNTYPE, locality same as U151.

G12248, (3), SYNTYPES locality same as U151.

= *Clavelina claviformis* (Herdman) — see Kott, 1957, p. 88.

coelenteratus, *Askonides* Kott (1962, p. 292, figs 25-28).

Y1343, HOLOTYPE, West Point, Western Australia, outer reef edge, 6.12.48., P. Kott.

Y1344, PARATYPE, Cape Vlamingh, Rottnest Island, Western Australia, 19.11.51.

Y1345, PARATYPE, Salmon Bay Rottnest Island, Western Australia, 18.11.51.

Y1346, PARATYPE, Green Pools, Albany, Western Australia, 16.1.1949.

Y1347, PARATYPE, Salmon Point, Rottnest Island, Western Australia, 18.11.1951.

columna, *Polycitor* Kott (1954, p. 152, fig. 34).

Y1297, SYNTYPE, Stn 113 Maria Island, Tasmania, 23.3.1931, B.A.N.Z.A.R.E.

complicata, *Agnesia* Kott (1954, p. 151).

U3910, (3), SYNTYPES, Stn 42, off Enderby Land, Antarctic, 22 m, B.A.N.Z.A.R.E.

= *Caenagnesia bocki* Arnback — see Kott, 1969, p. 96.

coniferum, *Aplidium* Kott (1963, p. 102).

U3921, HOLOTYPE, near Twofold Bay, New South Wales, 57-65 m, 6.8.1947, C.S.I.R.O. Fisheries.

crinitistellata, *Cynthia* Herdman (1899, p. 34, pl. Cyn IX figs 6-7; X fig. 13; XI figs 8-10).

U273 (G2068), SYNTYPE, Port Jackson, New South Wales.

G12230, SYNTYPE, locality same as U273.

= *Halocynthia hispida* (Herdman) — see Kott, 1968, p. 77.

cunninghami, *Polyzoa* Michaelsen (1898 p. 369)

G4158 SYNTYPE, Dungeness Point, Straits of Magellan

= *Polyzoa opuntia* (Lesson) — see Van Name 1945 p. 236.

cyanea, *Colella* Herdman (1899, p. 69, pl. Pcl IV figs 1-6).

U153, SYNTYPE, Port Jackson, New South Wales.

U346, SYNTYPE, locality same as U153.

= *Eudistoma cyanea* (Herdman) — see Kott, 1957, p. 72.

dagysa, *Podoclavella* Kott (1957, p. 93, figs 26-27).

Y1188, (10), SYNTYPES, Rottnest Island, Western Australia, shallow reef undercut, 16.11.1951, P. Kott.

digitatum, *Aplidium* Kott (1975, p. 7, fig. 8).

Y1982, PARATYPE, northern Great Australian Bight, 32°24'S, 130°30'E, 88 m, P. Symonds (C.S.I.R.O. prawn survey).

Note: Holotype is in South Australian Museum, E1030.

diminuta, *Clavelina* Kott (1957, p. 89)

Y1160, (3), SYNTYPES, Rottnest Island, Western Australia, reef undercut, 9.11.1951, P. Kott

= *Pycnoclavella diminuta* (Kott) — see Millar, 1963, p. 715.

directum, *Aplidium* Kott (1973, p. 246, fig. 5)

Y1110, HOLOTYPE, off Cronulla, New South Wales, 140 m, 16.1.1965, J. MacIntyre.

Y1111, PARATYPE, locality same as Y1110.

discoides, *Polysyncraton* Kott (1962, p. 303).

Y1482, HOLOTYPE, Fish Hook Bay, Rottnest Island, Western Australia, November, 1951, P. Kott.

dispar, *Ritterella* Kott (1957, p. 102, figs 33-34).

U3897, HOLOTYPE, Caloundra, Queensland, 17.1.1911, G. Buchanan.

= *R. proliferus* (Oka) — see Kott 1973, p. 245.

distomoides, *Amaroucium* Herdman (1899, p. 75, pl. Plc IV figs. 7-13).

G2106, HOLOTYPE, Port Jackson, New South Wales.

= *Distaplia distomoides* (Herdman) — see Kott, 1972b, p. 170.

draschii, *Microcosmus* Herdman (1899, p. 20, pl. Cyn III; IV).

U138 (G2079), HOLOTYPE, Port Stephens, New South Wales.

= *Herdmania momus* (Savigny) — see Kott, 1972a, p. 41.

elongata, *Amphicarpa* Kott (1952, p. 255, fig. 72)

Y1597, SYNTYPE, Trigg's Island, Western Australia, north end of outer reef, 29.12.1948.

Y1599, (2) SYNTYPES, locality same as Y1597.

emilionis, *Alloeocarpa* Michaelsen (1900, p. 35, Table II, fig. 21)

G4154, SYNTYPE, Port Stanley, Falkland Island, South Atlantic, Pene.

= *A. incrustans* (Herdman) — see Van Name 1945, p. 239.

etheridgii, *Styela* Herdman (1899, p. 38, pl. Cyn XIII figs 1-8).

U143 (G2071), SYNTYPE, Port Stephens, New South Wales

G12232, SYNTYPE, locality same as U143.

= *Cnemidocarpa etheridgii* (Herdman) — see Michaelsen and Hartmeyer 1927, p. 170.

fantasiana, *Eudistoma* Kott (1957, p. 76, figs 7-8).

Y1276, HOLOTYPE, Reevesby Island, South Australia, North end of the peninsula, December, 1926, McCoy Soc. Expedition.

= *Atapozoa fantasiana* (Kott) — see Kott 1972a, p. 7.

flora, *Ecteinascidia* Kott (1952, p. 316, figs 179-180).

U3903, SYNTYPE, 28°3'S, 113°E, 35 m, (station 122W/48), drift-net, C.S.I.R.O. Fisheries.

U3970, SYNTYPE, locality same as U3903.

fragile, *Psammaplidium* Herdman (1899, p. 86, pl. Plc VI figs 10-14).

U166 (G2110), HOLOTYPE, Port Jackson, New South Wales.

= *Aplidium arboratum* Kott — see Kott, 1963, p. 96.

Note: The new name given by Kott is unnecessary because *P. solidum* Herdman is available and should now be applied. Presumably Kott realised this later (see Kott 1974 p. 412 Table V). *P. fragile* G12250, listed by Kott 1963, p. 96 is not a type.

fungiformis, *Polycarpa* Herdman (1899, p. 43, pl. Cyn XVI figs 1-10).

U146 (G2081), HOLOTYPE, Moreton Bay, Queensland.

fuscum, *Polyclinum* Herdman (1899, p. 82, pl. Pcl III figs 1-6).

U156 (G2101), HOLOTYPE, Port Jackson, New South Wales.

gelatinosa, *Polycitor* Kott (1957, p. 83, fig. 15).

Y1310, SYNTYPE, Mary Cove, Rottnest Island, Western Australia.

= *P. giganteum* (Herdman) — see Kott 1972a, p. 9.

giganteum, *Polyclinum* Herdman (1899, p. 79, pl. Pcl II figs 1-2).

U163 (G2099), SYNTYPE, Port Jackson, New South Wales.

= *Polycitor giganteum* (Herdman) — see Kott, 1972a, p. 9.

globosum, *Eudistoma* Kott (1957, p. 72).

Y1275, SYNTYPE, Little Geordie Bay, Rottnest Island, Western Australia, 13.12.1948.

globosum *Polyclinum* Herdman (1899, p. 80, pl. Pcl II, figs 3-8).

U157 (G2100), SYNTYPE, Port Jackson, New South Wales.

G12253, (2), SYNTYPES, locality same as U157.

= *Polycitor giganteum* (Herdman) — see Kott 1972a, p. 9.

gordiana, *Polyzoa* Michaelsen (1900, p. 49, Table I, fig. 1).

U279 (G4153), SYNTYPE, South Falkland

= *Polyzoa opuntia* Lesson — see Van Name, 1945, p. 236.

gregaria, *Dendrodoa* Kesteven (1909, p. 291, pls XXV figs 1-3; XXVI fig. 7; XXVII figs 1-5).

U563, (20), SYNTYPES, Hobart, Tasmania, A. Moreton.

U562, (4), SYNTYPES, locality same as U563.

Note: 5 specimens were sent to Professor Hartmeyer.

imperfectus, *Askonides* Kott (1962, p. 294, fig. 29).

Y1348, HOLOTYPE, Reevesby Island, S.A., 9 m, December, 1936, McCoy Soc. Expedition.

Y1349, PARATYPE, south of Switzer reef, north Queensland, 25.9.1948.

incerta, *Ascidia* Herdman (1899, p. 11, pl. Asc. I figs 5-8).

U135 (G2088), HOLOTYPE, Port Jackson, New South Wales.

= *A. sydneyensis* Stimpson — see Kott, 1952, p. 310.

incrustans, *Psammaplidium* Herdman (1899, p. 87, pl. Pcl VI figs 1-6).

U167 (G2111), HOLOTYPE, Port Stephens, New South Wales.

= *Aplidium arboratum* Kott — see Kott, 1963, p. 96.

See note under *fragile*, *Psammaplidium*. *P. incrustans*, G12251 listed by Kott (1963, p. 96) is not a type.

intestinata, *Polycarpa* Kott (1952, p. 238, figs 48-49).

Y1750, HOLOTYPE, near Point Charles, Western Australia, 24°54'S, 113°16' E, (station 139W/48), 19.9.1948, C.S.I.R.O. Fisheries.

= *P. papillata* (Sluiter) — see Kott 1972a, p. 34.

Note: Kott (1952) records the type locality for the only described specimen (i.e. holotype) as Port Jackson, N.S.W. The locality details with the specimen labelled by Kott and returned to the Australian Museum are given above.

investum, *Synoicum* Kott (1963, p. 90, fig. 10).

U3928, HOLOTYPE, Bargara, Hervey Bay, Queensland, intertidal, under stones, 8.5.1961.

- jacksoni*, *Aplidium* Kott (1963, p. 110).
U3917, HOLOTYPE, Port Jackson, New South Wales, dredged.
- jacksoniana*, *Polycarpa* Herdman (1899, p. 50, pl. Cyn XIX figs 7-9).
G2085, HOLOTYPE, Port Jackson, New South Wales.
- jacksonianum*, *Sarcobotrylloides* Herdman (1899, p. 102, pl. Bot. II figs 1-8).
G2121, SYNTYPE, Port Jackson, New South Wales.
=*Botrylloides nigrum* Herdman — see Kott, 1952, p. 257.
- janis*, *Molgula* Kott (1952, p. 295, fig. 158).
Y792, (2), SYNTYPES, Victor Harbour, west side of Granite Island, South Australia, 25.1.1949, C.S.I.R.O. Fisheries.
Y1891, SYNTYPE, locality same as Y792.
=*M. mollis* Herdman — see Kott 1972a, p. 45.
- jugosum*, *Leptoclinum* Herdman & Riddell (1913, p. 886, pl. xcii figs 1-6).
G12205, SYNTYPE, off Port Jackson, 70-83 m, New South Wales.
G12206, SYNTYPE, off Coogee, 83-90 m, New South Wales.
G12207, SYNTYPE, Manning Bight, 30-33 m, New South Wales.
G12208, SYNTYPE, locality same as G12207.
G12209, SYNTYPE, Cape Three Points, 41-61 m, New South Wales.
Z1288, SYNTYPE, locality same as G12209.
Z1289, SYNTYPE, locality same as G12209.
Z1290, SYNTYPE, locality same as G12209.
Z1301, SYNTYPE, locality same as G12207.
Z1305, SYNTYPE, locality same as G12207.
=*Polysyncraton chondrilla* (Sluiter) — see Kott, 1962, p. 296, for G12205 and G12207.
Specimen G12204 listed by Kott is not a specimen of *L. jugosum* but *Distoma* sp. in the Museum Register.
=*Didemnum lambitum* (Sluiter) — see Kott, 1962, p. 317, for G12208, Z1288, Z1290, Z1305.
- The remaining three lots Z1301, G12206 and G12209 have not been definitely assigned to another species by Kott.
- kerguelensis*, *Molgula* Kott (1954, p. 137, figs 17-18).
Y1893, SYNTYPE, Stn 6, Kerguelen, Southern Ocean, 8-9 m, B.A.N.Z.A.R.E.
- kerguelensis*, *Leptoclinides* Kott (1954, p. 165).
Y1491, HOLOTYPE, off Kerguelen, Southern Ocean, 50 m, 22.2.1930, B.A.N.Z.A.
- lapidosa*, *Goodsiria* Herdman (1899, p. 99, pl. Pst III figs 1-12).
U352 (G2116), SYNTYPE, Port Jackson, New South Wales.
=*Polyandrocarpa lapidosa* (Herdman) — Kott, 1952, p. 250.
- leeuwinia*, *Pyura* Kott, (1952, p. 277, figs 118-121).
Y1840, SYNTYPE, north side of Trigg's Island, Western Australia, 27.12.1948.
Y1841, (2), SYNTYPES, locality same as Y1840.
- leptum*, *Botrylloides* Herdman (1899, p. 101, pl. Bot I figs 5-13).
U361 (G2120), SYNTYPE, Port Jackson, New South Wales.
Y1584, SYNTYPE, locality same as U361.
=*Botrylloides leachii* (Savigny) — See Kott, 1952, p. 258.
- leucophaeus*, *Chorizocormus* Herdman (1899, p. 97, pl Pst II, figs 1-6).
U169 (G2119), SYNTYPE, Port Jackson, New South Wales.

U284, SYNTYPE, locality same as U129.

Y1983, SYNTYPE, locality same as U129.

lissus, *Leptoclinides* Hastings (1931, p. 93, fig. 12).

G13449, HOLOTYPE, Stn xvi, Great Barrier Reef Expedition.

= *L. rufus* (Sluiter) — See Kott, 1962, p. 286.

littoralis, *Culeolus* Kott (1956, p. 59, figs 1-4).

Y1745, ? PARATYPES, Intertidal zone below lighthouse on Cuvier Bay, attached to *Pyura stolonifera*, Hunter Island, N.W. Tasmania, Miss I. Bennett.

Note: These specimens were accompanied by label describing them as 'co-types'. Kott reports that there is a holotype but this either has not been chosen or is not housed in The Australian Museum.

lobata, *Styela* Kott (1952, p. 222, figs 21-24).

Y1683, SYNTYPE, D'Entrecasteaux Channel, Tasmania.

lobatum, *Psammaphidium* Herdman (1899, p. 85, pl. Pl. V figs 6-12).

U164 (G2109), HOLOTYPE, Port Jackson, New South Wales.

= *Aplidium arboratum* (Kott) — see Kott, 1963, p. 96.

See note under *fragile*, *Psammaphidium*.

longata, *Styela* Kott (1954, p. 145, figs 28-29).

Y996, HOLOTYPE, off north east coast of Tasmania, 676-128 m, B.A.N.Z.A.R.E.

longitubis, *Polycitor* Kott (1957, p. 80, fig. 12).

Y802, HOLOTYPE, S.W. Australia.

Note: Kott recorded the holotype as being located in the University of W.A., but the specimen is now housed in the Australian Museum.

magnetæ, *Didemnum* (*Polysyncrator*) Hastings (1931, p. 100, fig. 15).

G13482, HOLOTYPE (part), Turtle Island, Queensland, 14 m, Great Barrier Reef Expedition.

= *Polysyncrator magnetæ* Hastings — see Kott, 1957, p. 303.

Kott's reference to A.M. G13485 is incorrect.

Part of the holotype is in the British Museum (Natural History), London.

marshi, *Atapozoa* Brewin (1956, p. 31, fig. 1).

U3843, HOLOTYPE, Trigg's Island, Western Australia, 20.12.1951, Mrs. L. Marsh.

Y1992, PARATYPE, locality same as U3843.

marsupiale, *Polyclinum* Kott (1963, p. 83, fig. 6).

U3915, HOLOTYPE, intertidal zone, Hunter Island, Bass Strait, Tasmania, January, 1952, Miss I. Bennett.

U3916, PARATYPE, locality same as U3915.

medusa, *Molgula* Kott (1952, p. 297, fig. 161).

Y794, SYNTYPE, Oyster Harbour, Albany, Western Australia, muddy bottom, December, 1948, C.S.I.R.O. Fisheries.

Y1900, SYNTYPE, locality same as Y794.

= *M. calvata* Sluiter — see Kott, 1964, p. 144.

meridionalis, *Podoclavella* Herdman (1899, p. 4, pl. Clav II figs 1-4).

U133 (G2091), HOLOTYPE, Port Jackson, New South Wales.

- minuta*, *Molgula* Kott (1952, p. 295, figs 159-160).
Y793, (c. 10), SYNTYPES, north outer reef and south undercut, Trigg's Island, off Fremantle.
- molguloides*, *Cynthia* Herdman (1899, p. 27, pl. Cyn VII figs 4-10).
U275, HOLOTYPE, Port Jackson, New South Wales.
= *Pyura molguloides* (Herdman) — see Kott, 1952, p. 271.
- mollis*, *Molgula* Herdman (1899, p. 54, pl. Mol I figs 1-4).
U150 (G2052), (4), SYNTYPES, Port Jackson, New South Wales.
G12226, (12), SYNTYPES, locality same as U150.
- mortoni*, *Molgula* Kesteven (1909, p. 289, pls. XXV figs 4-5; XXVI fig. 8; XXVII figs 11-12).
U559, HOLOTYPE, Hobart Harbour, Tasmania, 7-20 m, A. Morton.
= *M. sabulosa* (Quoy and Gaimard) — see Kott, 1952, p. 298.
- multilobata*, *Leptoclinides* Kott (1954, p. 166, figs 58-60).
Y1492, ? HOLOTYPE, off Maria Island, Tasmania, 174-155 m, 23.2.1931, B.A.N.Z.A.R.E.
- multiradicata*, *Cynthia* Herdman (1899, p. 30, pl. Cyn IX figs 1-5).
U384 (G2065), HOLOTYPE, Port Stephens, New South Wales, growing on *Styela whiteleggii* (= *S. pedata* — see p. 560).
= *Pyura spinifera* (Quoy & Gaimard) — see Kott, 1972c, p. 186.
- multistigmata*, *Perophora* Kott (1952, p. 313, figs 176-177).
U3904, SYNTYPE, Dunwich, Moreton Bay, Queensland, 6.11.1947, C.S.I.R.O. Fisheries.
U3969, SYNTYPE, locality same as U3904.
- nana*, *Ascopera* Herdman (1899, p. 57, pl. Mol I figs 10-14).
U268 (G2051), SYNTYPE, Port Jackson, New South Wales.
= ? *Molgula sabulosa* (Quoy and Gaimard) — see Kott, 1952, p. 298.
- nemorus*, *Parabotryllus* Kott (1975, p. 11, figs 11-15).
Y1981, PARATYPE, Upper Spencer Gulf, South Australia, 10 m, 5.9.1973, S. Shepherd.
Note: Holotype in South Australian Museum, E1031.
- nichollsi*, *Microcosmus* Kott, (1952, p. 290, figs 149-153).
Y1800 (2), SYNTYPES, Flinders Island, Victoria, 1.5.1935, A. Tubb.
- nigrum*, *Polyclinum* Herdman (1899, p. 84, pl. Pcl I figs 13-16).
U354, HOLOTYPE, Vaucluse Point, Port Jackson, New South Wales.
- opaca*, *Adagnesia* Kott (1963a, p. 76).
U3952, HOLOTYPE, ½ mile S.E. of Red Beacon, Toorbul Point, Moreton Bay, Queensland, 29.10.1962, W. Stephenson.
- opacum*, *Aplidium* Kott (1963, p. 108, figs 21-22).
U3929, HOLOTYPE, Balnarring Beach, Victoria, 22.8.1936, A. Tubb.
- orbiculum*, *Polysyncraton* Kott (1962, p. 300, figs 34-35).
Y1486, HOLOTYPE, Mary Cove, Rottnest Island, Western Australia, P. Kott.
Y1479, PARATYPE, Salmon Bay, Inner Pool, Rottnest Island, W.A., January 1945, 18.11.51.

- Y1480, PARATYPE, Cape Vlamingh, Rottnest Island, W.A., 19.11.51.
 Y1483, PARATYPE, Fish Hook Bay, Rottnest Island, W.A.
 Y1484, PARATYPE, Port Noarlunga, South Australia, January, 1949.
 Y1485, PARATYPE, Christie Beach, Port Noarlunga, S.A., February, 1948.
 Y1487, PARATYPE, Rottnest Island, W.A.

ordinatum, *Psammaphidium* Herdman & Riddell (1913, p. 885, pl. xci figs 6-12).

G12216, SYNTYPE, off Manning River, New South Wales, 39 m.

= *Aplidium ordinatum* (Herdman & Riddell) — see Kott, 1963, p. 99.

paessleri, *Styela* Michaelsen (1898, p. 368)

G4159 (3), SYNTYPES, Port Stanley, Falkland Islands, South Atlantic Ocean, Paessler.

pannosum, *Sarcobotrylloides* Herdman (1899, p. 105, pl. Bot III figs 1-5).

G2123, SYNTYPE, Port Stephens, New South Wales.

= *Botrylloides nigrum* Herdman — see Kott, 1952, p. 257.

papillata, *Styela* Kott (1954, p. 143, fig. 28).

Y1701, SYNTYPE, off Kempland (stn 34), B.A.N.Z.A.R.E., 602 m.

Y1702, SYNTYPE, off MacRobertson land (stn 30), B.A.N.Z.A.R.E., 456 m.

= *S. nordenskjoldi* Michaelsen — see Kott, 1969, p. 112.

parvum, *Aplidium* Kott (1963, p. 112, fig. 26).

Y1418, SYNTYPE, San Remo, Victoria, 3.6m, 18.10.36, A. Tubb, McCoy Soc.

parvispinatus, *Pyura australis* Kott (1952 p. 268 figs 97, 98).

Y1832, HOLOTYPE, Robb's Jetty, Fremantle, Western Australia.

= *P. australis* (Quoy and Gaimard) — see Kott, 1972c, p. 186.

pavementis, *Styela* Kott (1952, p. 226, figs 30-31).

Y1696, HOLOTYPE, Thompson's Bay, Rottnest Island, Western Australia, piles of jetty, 16.12.1948, C.S.I.R.O. Fisheries.

pedunculatum, *Psammaphidium* Herdman (1899, p. 88, pl. Pl VI figs 7-9).

U281 (G2112), SYNTYPE, ? Port Jackson, New South Wales.

= *Ritterella herdmania* Kott — see Kott, 1957, p. 102.

Note: Kott's species name is invalid as a replacement for Herdman's species name, since Tokioka's species name is the junior homonym, if the two species are congeneric as Kott maintains.

personata, *Styela* Herdman (1899, p. 41, pl. Cyn XV figs 1-7).

U144 (G2074) (3), SYNTYPES, Port Jackson, New South Wales.

= *Cnemidocarpa etheridgii* (Herdman) — see Kott, 1972a, p. 31.

phallusioides, *Ascidia* Herdman (1899, p. 12, pl. Asc II).

U136 (G2089), SYNTYPE, Port Jackson, New South Wales.

U252, SYNTYPE, locality same as U136.

U235 (2), SYNTYPES, locality same as U136.

U259 (G2090), SYNTYPE, locality same as U136.

= *Phallusia depressiuscula* Heller — see Kott 1966a, p. 293.

pinguis, *Styela* Herdman (1899, p. 37, pl. Cyn XII figs 1-10).

U141 (G2070) (2), SYNTYPES, Port Jackson, New South Wales.

= *S. plicata* (Lesueur) — see Kott, 1952, p. 216.

plana, *Monoandrocarpa* Kott (1973 p. 250, figs 6, 7).

Y852 HOLOTYPE, off Cronulla, New South Wales, 160-180 m, 16.6.65, collected J. MacIntyre.

Y853, (3), PARATYPES, locality same as Y852.

plana, *Polycarpa aurata* Herdman (1899, p. 51, pl. Cyn XX figs 1-5).

U256 (G2077), HOLOTYPE, Port Jackson, New South Wales.

plicata, *Ascidia* Kott (1954, p. 150, fig. 31)

Y1662 (12), SYNTYPES, off Kerguelen (stn 59), 47m B.A.N.Z.A.R.E. 22.2.30.

= *A. translucida* Herdman — see Kott, 1969, p. 93.

plicata, *Colella* Herdman (1899, p. 62, pl. Dis II figs 1-15).

U152 (10), SYNTYPES, Port Jackson, New South Wales.

U299-U317 (18), SYNTYPES, locality same as U152.

= *Sycozoa cerebriformis* (Quoy and Gaimard) — see Brewin, 1953, p. 58.

plicata, *Pyura* Kott (1952, p. 278, fig. 122).

Y1856, HOLOTYPE, Hamelin Bay, Western Australia, on jetty piles, 14.1.1949.

protectans, *Amaroucium* Herdman (1899, p. 73, pl. Pcl III figs 7-10).

U160 (G2105), HOLOTYPE, Port Jackson, New South Wales.

= *Aplidium protectans* (Herdman) — see Kott, 1963, p. 102.

prunum, *Polyclinum* Herdman (1899, p. 83, pl. Pcl IV figs 14-16).

U159 (G2102), HOLOTYPE, Port Jackson, New South Wales.

= *Synoicum prunum* (Herdman) — see Kott, 1963, p. 87.

pseudobaudinensis, *Oxycorynia* Kott (1976, p. 54, fig. 1).

Y113, HOLOTYPE, Laverton Bay, Victoria.

Y1112, PARATYPE, Rottnest Island, Western Australia.

Y1122, PARATYPE, Balnarring Beach, Victoria.

Note: Both generic and specific names appear to be incorrectly spelt by Kott (*Oxycotinia pseudobaudiensis*) at the heading of the description of this species, which is herein treated as a *lapsus calami*. (Art 32a (ii), I.C.Z.N., 1961).

pseudobesum, *Aplidium* Kott (1963, p. 101).

Y1292, HOLOTYPE, Tathra, near Green Cape, New South Wales, 95 m, 14.10.1938, C.S.I.R.O.

U3924, PARATYPE, Eden, New South Wales, 50 m, 11.10.1948.

U3922, PARATYPE, locality same as U3924.

pseudodiplosoma, *Didemnum* Kott (1962, p. 321, fig. 47).

Y1527, HOLOTYPE, Port Noarlunga, South Australia, on jetty, January, 1949, P. Kott.

Y1526, PARATYPE, locality same as Y1527.

punctans, *Sidnyum* Kott 1954, p. 177.

Y918, HOLOTYPE, Commonwealth Bay, B.A.N.Z.A.R.E.

= *Aplidium circumvolutum* (Sluiter) — see Kott, 1969, p. 57.

purpureum, *Sarcobotrylloides* Herdman (1899, p. 104, pl. Bot III figs 6-10).

U171 (G2122), SYNTYPE, Port Jackson, New South Wales.

= *Botrylloides magnicoecum* Hartmeyer — see Michaelsen, 1922, p. 480.

radiatum, *Sidnyum* Kott (1954, p. 176).

Y1078, HOLOTYPE, Royal Sound, Kerguelen, B.A.N.Z.A.R.E., 2.3.1930.

= *Aplidium globosum* (Herdman) — see Kott, 1969, p. 55.

ramificata, *Styela* Kott (1952, p. 214, figs 3-5).

Y1691, HOLOTYPE, south side of Peel Island, Moreton Bay, Queensland, 3.11.1948.

ramsayi, *Microcosmus* Herdman (1899, p. 25, pl. Cyn VI figs 1-5).

G2061 (12), SYNTYPES, Port Jackson, New South Wales.

= *M. australis* Herdman — see Millar, 1963, p. 741.

rectangularis, *Styela* Kott (1952, p. 224, figs 27-29).

Y1700, SYNTYPE, Fremantle, Western Australia, collected from either on jetty piles, traffic jetty or hull of "Bonthorp", 9.1.1949.

Y783, SYNTYPE, same locality as Y1700.

rotnesti, *Didemnum* Kott (1962, p. 322, fig. 49).

Y1515, HOLOTYPE, Mary Cove, Rottnest Island, Western Australia, reef undercut, 1.11.1951, P. Kott.

Y1523, PARATYPE, off Maria Island, Tasmania (stn 113) B.A.N.Z.A.R.E.

rotundatum, *Amaroucium* Herdman (1899, p. 71, pl. Pcl I figs 1-4).

U162 (G2104), HOLOTYPE, Port Jackson, New South Wales.

= *Aplidium rotundatum* (Herdman) — see Kott, 1963, p. 92 (in Key).

rubricollum, *Aplidium* Kott (1963, p. 103, fig. 14).

Y1417, HOLOTYPE, Reevesby Is., South Australia, December, 1936.

Y1403, PARATYPE, Thompson's Bay, Rottnest Island, Western Australia, 18.12.48.

Y1415, PARATYPE, Balnarring Beach, Vic. 27.7.1936, A. Tubb.

sacciformis, *Polycarpa* Herdman (1899, p. 48, pl. Cyn XIX figs 1-4).

U249 (G2084), HOLOTYPE, Port Jackson, New South Wales.

sluiteri, *Polycarpa* Herdman (1899, p. 46, pl. Cyn IV fig. 1 p1, Cyn XVII figs 6-9).

U254 (G2083), HOLOTYPE, Port Jackson, New South Wales.

= *P. tinctor* (Quoy and Gaimard) — see Kott, 1964, p. 134.

Note: specimen is attached to *Ascidia phallusioides* (U252); syntype, *Molgula forbesii* (U253) and *M. draschii* (U255).

solanoides, *Cynthia* Herdman (1899, p. 29, pl. Cyn VIII).

U360 (G2164), HOLOTYPE, Port Jackson, New South Wales.

? = *Microcosmus australis* (Herdman) — see Kott, 1976, p. 85.

solidum, *Psammaplidium* Herdman (1899, p. 85, pl. Pcl VI figs 1-5).

U165 (G2108), HOLOTYPE, Port Jackson, New South Wales.

= *Aplidium arboratum* Kott — see Kott, 1963, p. 96.

See note under *fragile*, *Psammaplidium*.

spiculatum, *Trididemnum* Kott (1962, p. 281, figs 12-13).

Y1626, HOLOTYPE, Thompson's Bay, Rottnest Island, Western Australia, off *Styela etheridgii*, (= *Cnemidocarpa etheridgii* — see p. 551). P. Kott, 8.12.1948.

Y1619, PARATYPE, east end of Wreck Bay, Tasmania, on rocks, 29.3.1939.

Y1624, PARATYPE, locality same as Y1619.

Y1627, PARATYPE, Heron Island, Queensland, May, 1961.

Y1628, PARATYPE, Parrakeet Bay, Rottnest Island, Western Australia, from reef undercut, 14.12.1948.

Y1629, PARATYPE, Outer Harbour, South Australia, 27.1.1949.

Y1630 PARATYPE, Point Peron, Western Australia, outer edge of reef, 6.12.1949.

- Y1631, PARATYPE, Thompson's Bay, Rottnest Island, Western Australia, January, 1949.
Y1632, PARATYPE, Basin, Rottnest Island, Western Australia, reef undercut, 15.11.1951.
- spinifera*, *Cynthia* Herdman (1899, p. 32, pl. Cyn X figs 1-12).
G2067, HOLOTYPE, Port Jackson, New South Wales.
= *Microcosmus spiniferus* (Herdman) — see Kott, 1952, p. 286.
- spiralis*, *Molgula* Kott (1954, p. 134).
Y1921, HOLOTYPE, Enderby Land (stn 41), B.A.N.Z.A.R.E.
= *M. malvinensis* Arnback — see Kott, 1969, p. 149.
- stephenensis*, *Polycarpa* Herdman (1899, p. 45, pl. Cyn XVII figs 1-5).
U148 (G2082), HOLOTYPE, Port Stephens, New South Wales.
= *P. pedunculata* Heller — see Kott, 1972a, p. 35.
- stolonifera*, *Microcosmus* Kott (1952, p. 291, figs 154-156).
Y1798, SYNTYPE, Coast of King Island, Bass Strait, 3.12.1948.
- stolonifera*, *Styela* Herdman (1899, p. 41, pl. Cyn XV figs 8-11).
U145 (G2075), HOLOTYPE, Moreton Bay, Queensland.
- subarborensis*, *Polycitor* Kott (1957, p. 81, fig. 14).
Y1298, HOLOTYPE, Ulladulla, New South Wales, 81 m, 4.1.1945, D. Rochford.
- subfuscus*, *Chorizocormus* Herdman (1899, p. 96, pl. Pst I figs 8-11).
U272 (G2118), HOLOTYPE, Port Jackson, New South Wales.
- sydneyensis*, *Chorizocormus* Herdman (1899, p. 95, pl. Pst I figs 1-7).
U261, SYNTYPE, Port Jackson, New South Wales.
U257, SYNTYPE, locality same as U261.
- sydneyensis*, *Molgula* Herdman (1899, p. 55, pl. Mol I figs 5-9).
U267 (G2053), HOLOTYPE, Port Jackson, New South Wales.
= *M. mollis* Herdman — see Kott, 1952, p. 298.
- tamaramae*, *Sidneioides* Kesteven (1909, p. 278, pls xxv fig. 9; xxvi figs 1-6).
U564, HOLOTYPE, Tamarama Bay, Sydney, New South Wales.
- tasmanoides*, *Sycozoa* Kott (1954, p. 157, fig. 41).
Y1231, SYNTYPE, Maria Island, Tasmania 174-155 m (stn 113), B.A.N.Z.A.R.E.
- tenuicaulis*, *Colella* Herdman (1899, p. 64, pl. Dist. I figs 1-16).
U326-330, SYNTYPE, Port Stephens and Port Jackson, New South Wales.
U383, SYNTYPE, locality same as U326-330.
= *Sycozoa pedunculata* (Quoy and Gaimard) — see Kott, 1972b, p. 234.
- tenuis*, *Molguloides* Kott (1954, p. 138, figs 19-21).
Y1172 (2), SYNTYPES, off MacRobertson Land (stn 29), 1266 m, B.A.N.Z.A.R.E.
= *M. vitrea* (Sluiter) — see Kott, 1969, p. 159.
- thetiense*, *Psammaplidium* Herdman & Riddell (1913, p. 884, pl. xci figs 1-5).
G12218, HOLOTYPE, coast of New South Wales.
= *Aplidium lobatum* Savigny — see Kott, 1963, p. 97.
- thompsoni*, *Ascidia* Kott (1952, p. 312, figs 174-175).
Y1668, HOLOTYPE, Great Taylor Bay, Tasmania, 9 m, on scallop shell, 25.5.1941.

translucida, *Polycitor* Kott (1957, p. 81, fig. 13).

Y1301, SYNTYPE, Point Peron, west of Point John, Western Australia, reef undercut, 8.12.1948.

triggiensis, *Polyandrocarpa* Kott (1952, p. 248, fig. 62).

Y1574, SYNTYPE, Trigg's Island, north outer reef, Western Australia, 29.12.1948, C.S.I.R.O. Fisheries.

Y1575, SYNTYPE, same locality as Y1574.

triggsensis, *Aplidium* Kott (1963, p. 104, fig. 16).

U3923, HOLOTYPE, Trigg's Island, near Fremantle, Western Australia, on wall of reef undercut, 29.12.1949.

Y1405, PARATYPE, Shelly Beach, Nornalup, Western Australia, 29.1.1939.

Y1408, PARATYPE, Trigg's Island, Western Australia, 29.12.1948.

Y1421, PARATYPE, Rottnest Island, Western Australia, 19.12.1948.

Y1427, PARATYPE, Balnarring Beach, Victoria, 7.3.1936.

Y1428, PARATYPE, Thompson's Bay, Rottnest Island, Western Australia, 18.12.1948.

Note: Kott (1976, p. 61) refers to this species as *triggiensis* but in the original description the name is spelt *triggsensis* which in this case must be the spelling of the name adopted (Art 32a (ii), I.C.Z.N., 1961).

tuberculata, *Boltenia* Herdman (1899, p. 17, pl. Cyn II).

U286 (2), SYNTYPES, Port Jackson, New South Wales.

U290 (G2056) (4), SYNTYPES, locality same as U286.

U350 (G2057) (2), SYNTYPES, locality same as U286.

= *Pyura spinifera* (Quoy and Gaimard) — see Kott, 1952, p. 269.

unilineata, *Polycarpa* Kott (1952, p. 246, figs 59-61).

Y1776, HOLOTYPE, Mackay, Queensland, 10 m, 12.6.1939, C.S.I.R.O. Fisheries.

valentinae, *Corella* Kesteven (1909, p. 286, pls xxv figs 6-8; xxvi fig. 9; xxvii figs 6-10).

U565 (8), SYNTYPES, Hobart Harbour, Tasmania, 9 m.

U566 (2), SYNTYPES, locality same as U565.

whiteleggii, *Styela* Herdman (1899, p. 40, pl. Cyn II figs 1-6).

U142, SYNTYPE, Port Stephens, New South Wales.

U282, SYNTYPE, Port Jackson, New South Wales.

= *Styela pedata* (Herdman) — see Kott, 1972c, p. 185.

zschaui, *Alloeocarpa* Michaelsen (1900, p. 32, pl. 11 fig 20).

U279, SYNTYPE, South Georgia, German South Polar Exped. 1882-3.

= *Alloeocarpa incrustans* (Herdman) — see Van Name, 1945, p. 239.

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THE GENUS *PTECTICUS* LOEW FROM AUSTRALIA,
NEW GUINEA AND THE BISMARCK AND SOLOMON
ARCHIPELAGOS
(DIPTERA: STRATIOMYIDAE)

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ABSTRACT

Fourteen species of the genus *Ptecticus* Loew are recognised and described or redescribed from Australia, New Guinea and the Solomon Islands and a key for their identification given. *P. albitarsus* de Meijere is established as a synonym of *P. quadrifasciatus*. *P. tritus* is proposed as a replacement name for *P. salomonensis* Lindner. The new species, *P. amplior* (from Australia and New Guinea), *P. queenslandicus* (Australia), *P. helvolus* (New Guinea), *P. spatuloides* (New Britain), *P. gilvus* (New Ireland) and *P. substitutus* and *P. eximius* (Solomons) are described. The male terminalia of thirteen species are illustrated.

Attention is drawn to the posttegula, a thoracic appendage medial to the base of each haltere. Its application as a character for the separation of the superfamilies Tabanoidea and Asiloidea is briefly discussed.

INTRODUCTION

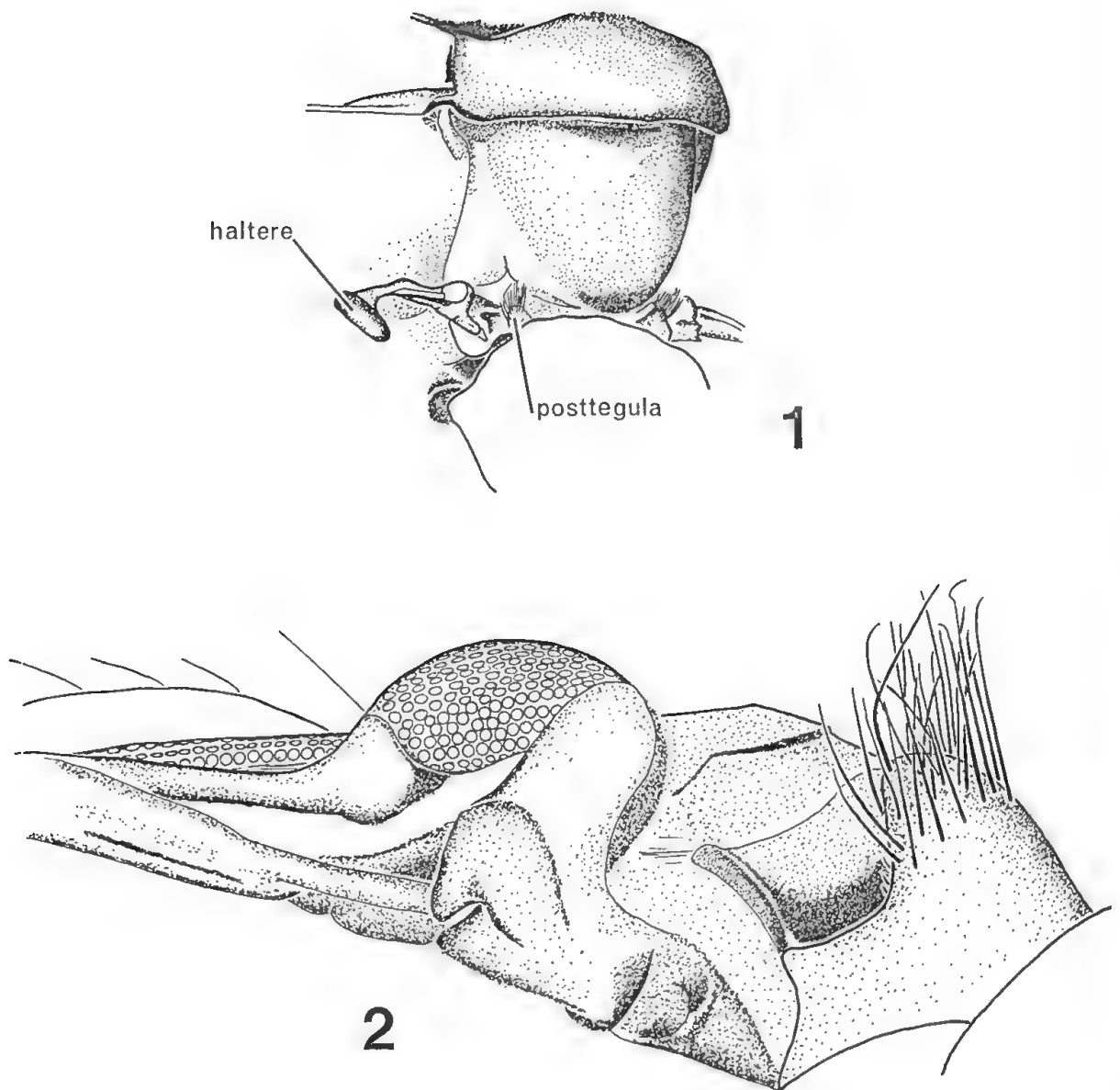
This study of *Ptecticus* from New Guinea, Australia, the Bismarcks and the Solomons, is the outcome of the collection and subsequent efforts to identify over 30 specimens of the genus from Australia, where it was previously unrecorded (Nagatomi, 1975).

Previous authors, such as Lindner, van der Wulp, Bigot and de Meijere, have each recorded small numbers of specimens and species from various localities in New Guinea. With the generous loan of material housed in the Bishop Museum it became apparent that little was known regarding the distribution of the genus within the area and that several new species were represented in this material.

The last revision involving New Guinea species was by Brunetti (1923) who dealt with all species known to him from the "Oriental" region. The present study, based mostly on material housed in the Bishop Museum, places the number of species from the area at 14 of which 5 are described as new. It is scarcely likely that this represents the total number of species, especially from New Guinea, and more intensive collecting will undoubtedly result in the discovery of further species. Study of available types has revealed a number of misidentifications and some new synonymy has also been found, all of which is discussed below.

Whilst reviewing *Ptecticus*, it was found that a useful species grouping character was the presence of a tuft of either orange or black hairs, placed medially and basally to each haltere (Fig. 1). Further investigation showed the appendage from which these hairs arose, named the posttegula, has affinities with the squama or tegula of the wing and in fact is possibly the remnant of one of these lobes of the hindwing or haltere.

The subfamilies of Stratiomyidae examined have the posttegula well developed and haired, Lophatellinae and Pachygasterinae being exceptions in having a predominance of genera with the posttegula bare, or rarely, sparsely haired.



Figs 1, 2. *P. quadrifasciatus* (Walker): (1) Subcutellar area and haltere showing location of posttegula; (2) Base of haltere and posttegula.

Amongst the Brachycera: Orthorrhapha, the posttegula is best developed and readily examined in Stratiomyidae, as the abdomen is rarely enlarged or basally flush with the thorax. Preliminary investigation has shown that in some families, notably Asilidae, Mydidae and Therevidae the posttegula is completely wanting. The genera examined of Pelecorhynchidae, Tabanidae and Nemestrinidae have the posttegula present, but not as well developed as in the Stratiomyidae, and usually elongated and reduced in height. Present indications show the posttegula developed amongst Tabanoidea and absent in Asiloidea (definition of Colless and McAlpine, 1970). The Bombyliidae could be an exception. Placed by Colless and McAlpine in the Asiloidea, the Bombyliidae appear to have some genera with a reduced posttegula and absent in others. Hennig (1973) placed the Bombyliidae in the infraorder Homoeodactyla (=Tabanoidea). Present indications are that the Bombyliidae are better placed in the Asiloidea. A more detailed investigation as to the presence or absence of the posttegula amongst the Orthorrhapha is in progress.

The posttegula shows some degree of interspecific variation in *Ptecticus* and its shape, length and density of hairs, could be of some value at specific level. The only character referred to in this paper is the colour of the dorsal tuft of hairs.

Viewed dorsally the posttegula is seen to be positioned basally and medially to the halteres and consists of a flat appendage with a semi-cylindrical basolateral lobe. Viewed laterally (Fig. 2), the lobe is seen to be convex dorsally, with a group of numerous, relatively stout hairs arising from the dorsal surface.

Material was examined from the following collections, abbreviated as follows:

AM	Australian Museum, Sydney
ANIC	Australian National Insect Collection, C.S.I.R.O., Canberra
BPBM	Bernice P. Bishop Museum, Hawaii
GD	Author's collection.
SAM	South Australian Museum, Adelaide.
ZMA	Instituut voor taxonomische Zoologie (Zoologisch Museum), Amsterdam.

For convenience New Guinea is divided into quadrants as defined in Gressitt and Szent-Ivany (1968).

Genus *Ptecticus* Loew

Ptecticus Loew 1855: 142. Type-species *Sargus testaceus* Fabricius, by original designation.

Eyes separated in both sexes, sparsely haired; facets larger towards inner margin. Frons divided into upper and lower sections, both of which are elongate-triangular in male (rarely elongate-trapezoidal) and elongate-trapezoidal in female; lower frons bulbous; narrowest point of frons situated just above bulbous portion of lower frons. Ocellar triangle situated distinctly before a line drawn between uppermost corner of each eye. Face divided into upper and lower parts, the lower face membranous, but broadly sclerotized medially. Palpi straplike, greatly reduced, concealed under the enlarged labellum. Antennal segment 2 conspicuously produced forward on apical inner margin; apical margin of segment 3 straight or nearly so; arista arising dorsoapically from segment 3. Humeral callus bare. Subscutellum enlarged. Posttegula densely and finely haired dorsally. Base of vein R_{2+3} situated at or slightly basal to r-m crossvein. Males with enlarged empodium. Pile of abdomen short and fine. Posterior margins of abdominal tergites 1-5 fused laterally. Tergites 7 and 8 of males reduced to a narrow sclerotized band anteriorly and laterally, membranous medially (Fig. 3). Male hypopygium rotated 90 degrees (except in *isabelensis*, with only slight medial reduction in tergite 7). Aedeagus

consisting of a single eversible duct; basal half moderately sclerotized, distal half membranous with minute reclinate hook-like processes (Fig. 3) in most species.

Ptecticus is widely distributed over the world, but is not present in Europe, Micronesia or Polynesia, although 31 species are reported from the Oriental region (James, 1975). *Ptecticus* is closely related to *Sargus* Fabricius, and may be distinguished by the following characters: Squama without strap-like process; section of Rs between r-m crossvein and R_{2+3} absent or almost as long as r-m; lower frons bulbous, sharply separated from upper frons; second antennal segment conspicuously produced forward apically on inner margin.

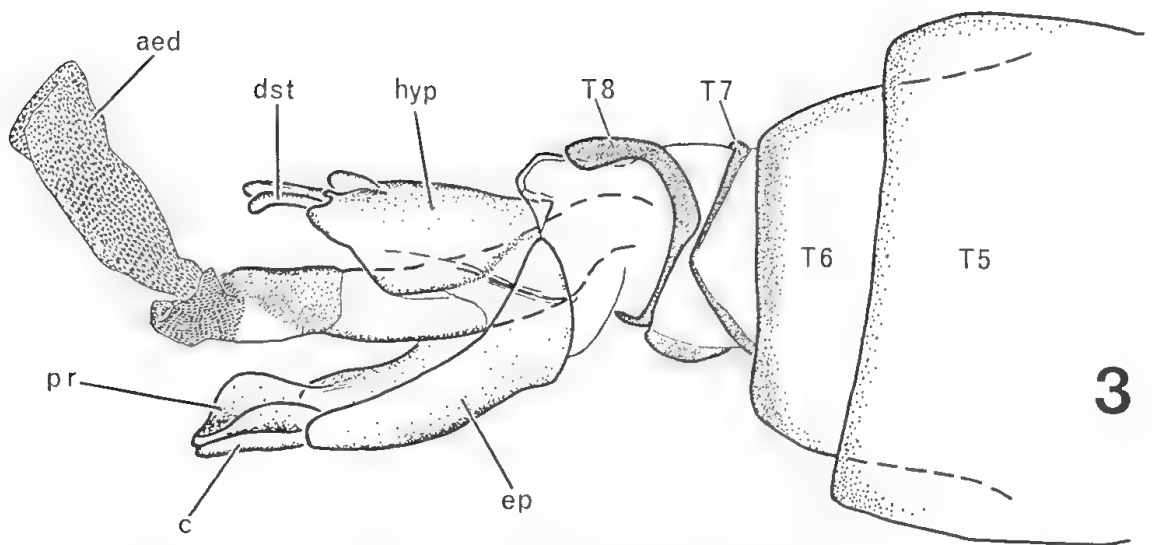


Fig. 3. *P. amplior* sp. n.: hypopygium viewed dorsally. *aed*, aedeagus, *c*, cerci; *dst*, dististyle; *ep*, epandrium; *hyp*, hypandrium; *pr*, proctiger, *T*, tergite.

KEY TO SPECIES OF *PTECTICUS* FROM AUSTRALIA, NEW GUINEA AND
THE BISMARCK AND SOLOMON ARCHIPELAGOS

1. Vein M_3 ending at least one third its length before wing margin; mesonotum and abdomen shining blue-black..... 2
 Vein M_3 ending almost at wing margin; mesonotum and abdomen orange-yellow or brownish, abdomen sometimes with black markings..... 3
2. Wing tips broadly infuscated; a large shining, blue-black lateral spot on anepisternite and sternopleuron (New Guinea)*archboldi* Lindner
 Wings hyaline; anepisternite deep blue, dorsal margin with a distinct yellow line; remainder of pleura deep brown with a bluish sheen (New Guinea, Solomons)*tritus* n.n.
3. Vein M_1 , in basal area of discal cell, convex; r-m opposite origin of M_3 4
 Vein M_1 , in basal area of discal cell, sinuous; r-m distinctly proximal to origin of M_3 7
4. Hind leg completely black; tergites 4-6 black (New Guinea)*papuanus* (Bigot)
 Hind femur yellow or yellow-orange; hind tibia black; tergites variable 5
5. Wings deep brown, almost black on costal margin; abdomen yellow-orange, shining and distinctly spatulate; males with relatively wide frons (New Britain)*spatuloides* sp. n.
 Wings hyaline, at most only slightly tinted along costal margin; abdomen never distinctly spatulate; frons of male variable 6
6. Hind metatarsus black; tarsal segments 2-4 white, abdominal tergites 4-7 completely black (Solomon Islands)*isabelensis* Lindner
 Hind tarsus black; abdomen orange-yellow without black markings (New Guinea, Manus Island, New Ireland)*ferrugineus* (Doleschal)
7. Tergites uniformly yellow or yellow-orange, without black markings, although black setae are sometimes present giving brownish markings; hairs on posttegula yellow 8
 Tergites with yellow or yellow-orange ground colour and distinct black bands; hairs on posttegula black..... 12
8. Upper frons shining yellow, darker than pale yellow lower frons; hind tarsus yellow or yellow-brown (New Guinea)*helvolus* sp. n.
 Upper frons shining black; other characters variable 9
9. Costal wing margin deep brownish distally, yellow tinted proximally; fore and mid tarsal segments 3-5 with a few black setae, the general colour of these segments not sharply contrasting with basal segments (Australia, New Guinea)*amplior* sp. n.
 Costal area not appreciably darkened, wing more or less uniformly yellow hyaline; fore and mid apical tarsal segments black setose, sharply contrasting with basal segments..... 10

10. Hind tarsus black, black setose (Australia).....*queenslandicus* sp.n.
Hind metatarsus never black, but some black setae present..... 11
11. Upper frons and face below antennal bases with yellowish fine setae; fore and mid tarsal segments 3-5 black-setose (Solomons).....*substitutus* sp. n.
Upper frons and face below antennal bases with fine black setae; fore and mid apical tarsal segment black-setose (New Ireland)*gilvus* sp. n.
12. Hind tarsus completely black, black-setose; tergites 2-5 black medially, distinctly surrounded by orange ground colour, though ground colour sometimes narrow anteriorly (New Guinea).....*complens* (Walker)
Hind tarsus not completely black; tergites otherwise marked..... 13
13. Tergite 1 with a brownish basolateral mark; anterior half of tergites 2-5 black; tergite 6 orange; hind tarsus with at least segments 3-5 white, white setose (New Guinea, New Ireland, Australia).....*quadrifasciatus* (Walker)
Tergite 1 without basolateral mark; anterior third of tergites black, except towards lateral margins. Hind tarsus brownish orange (Solomons) ..*eximius* sp. n.

***Ptecticus archboldi* Lindner**

Ptecticus archboldi Lindner, 1957: 189.

I have not examined material of this species. Lindner's description of *P. archboldi* agrees extremely well with most of the characters in Brunetti's (1923: 140) redescription of *P. longipennis* (Wiedemann), the redescription being based on the ♂ "type". At present it would appear that *P. archboldi* is a synonym of *P. longipennis* but an examination of the types is necessary to confirm this. *P. archboldi* is known only from the type locality, Sigi Camp, 1500 m, N.W. New Guinea.

***Ptecticus tritus* n.n.**

(Figs 4-6)

Ptecticus longipennis salomonensis Lindner, 1937: 372, not *P. salomonensis* Lindner, 1937: 370.

Ptecticus salomonensis Lindner. — James, 1948: 196.

Head: Width 1.3 height; frons at narrowest point 0.01 head width; relative width of frons: at narrowest point 1; at vertex 13; at antennal base 13-15. Upper frons and vertex shining blue-black, covered with fine hairs. Ocellar hairs black. Lower frons pale yellow, arising abruptly with almost straight dorsal and ventral margins, rounded apically with a few short fine pale hairs ventrally. Face yellowish with numerous fine pale yellow hairs on upper half, mostly as long as first antennal segment. Antenna orange; segment 1 dorsally and ventrally black haired; segment 2 distinctly convex on outer margin; with a row of apical black marginal hairs. Arista black. Labellum orange. **Thorax:** Mesonotum shining blue-black, with fine short pale hairs. Humeral callus, postalar callus and apical margin of scutellum brownish; mesonotal suture also indistinctly brownish. Subscutellum shining blue-black, brownish on anterior margin. Anepisternite shining blue-black, though not as deeply coloured as mesonotum, dorsal margin distinctly yellow, sharply differentiated from blue-black area. Pteropleuron and pleurotergite dark brown with a blue sheen, pale-haired. Sternopleuron deep brown, paler on dorsal margin and with a stronger blue sheen than pteropleuron and pleurotergite. Remainder of pleura variable, yellow-brown to deep brown. Posttegula brownish, pale-haired. Halteres with apical half black-brown,

basally brownish. *Legs*: including coxae, yellow-brown. Fore and mid femora, and posterior surface of hind femur yellow-haired; hind femur dark brown, black-haired dorsally and anteriorly. Fore and mid tibiae yellow-haired dorsally, black-haired ventrally, hind tibia black, black-haired. Fore and mid tarsi yellow-haired with a few black elements along dorso-medial line; segments 4 and 5 entirely black-haired; empodium and pulvilli yellowish; hind tarsi white, white-haired; metatarsus black on basal third, black-haired; apical hairs on apical segment black. *Wings*: hyaline, veins brownish, basally orange. Vein M_2 and vein M_3 almost straight, parallel, M_3 ending about one third its length before wing margin. *Abdomen*: shining blue-black. Postero-lateral tergal margins sometimes with an orange-brown spot. Hairs mostly black, laterally white. *Hypopygium* (Figs. 4-6) black-brown.

♀: differs from ♂ as follows:

Head: Frons at narrowest point 0.1 width of head; relative widths of frons: at narrowest point 1, at vertex 1.6 and at antennae 1.7. Thorax generally with a deeper brown basal coloration on pleura. *Abdomen* also with a stronger brown basal colouring. Ovipositor deep brown; cerci black.

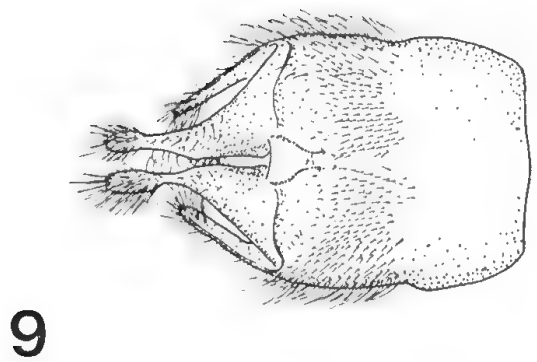
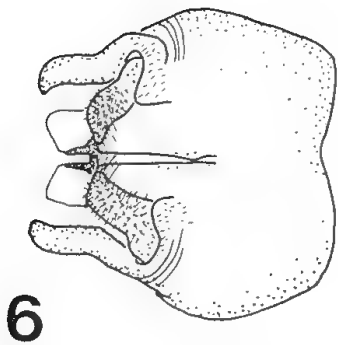
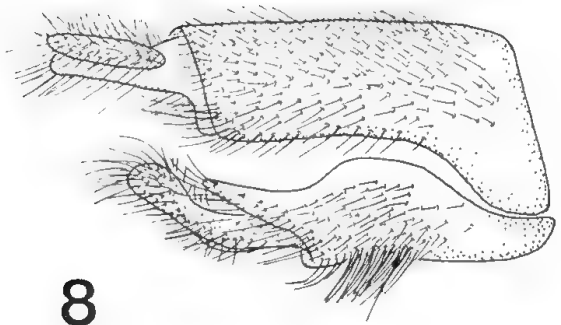
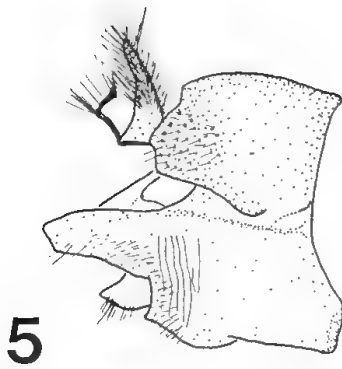
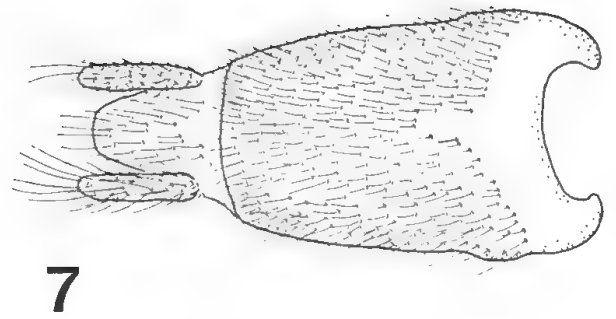
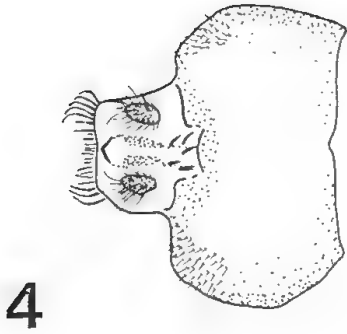
DIMENSIONS: body length, ♂ 10.0-12.8 mm, ♀ 9.5-12.1 mm; length of thorax, ♂ 2.7-3.8 mm, ♀ 2.6-3.5 mm; length of wing, ♂ 9.5-13.0 mm, ♀ 9.0-12.4 mm.

MATERIAL EXAMINED: NE NEW GUINEA: 1♂ Ambunti, Sepik River, 200 m, 5.v.1963 R. Straatman, night trap (BPBM); 1♂ May River, 100 m, 8.vi.1963, R. Straatman, night trap (BPBM); 1♂ Bulolo, 800-900 m, 19.xii.1961, S. and L. Quate (BPBM); 1♀ Finschhafen, 80 m, 16.iv.1968, J. Sedlacek, Malaise trap (BPBM). SE NEW GUINEA: 1♂ Brown River, 5 m, 23.v.1960, J. L. Gressitt (BPBM); 1♂ Milne Bay, 10 m, iii.1965, R. Straatman, night trap (BPBM); 8♂6♀ Mamai Plantation, E of Port Glasgow, 150 m, 6-16.ii.1965, R. Straatman, night trap (BPBM, 1♂, 1♀AM). SOLOMON ISLANDS: MALAITA: 4♂Dala, 24-25.vi.1964, R. Straatman, Malaise trap, (BPBM); 1♀ Auki, 20 m, 3-5.vi.1964, J. M. Sedlacek, MV light (BPBM). FLORIDA GROUP: 2♂Haleta, 250 m, Nggela Is, 17.x.1964, R. Straatman, Malaise trap (BPBM); 1♂ Tanatan Cove, near Dende, Small Nggela, 17.ix.1960, C. W. O'Brien (BPBM). Vella Lavella: 5♂, 5♀ Kundurumbangara, 80 m, 19-23.xi.1963, P. Shanahan, Malaise trap, (BPBM, 1♂, 1♀AM); 1♀ Malawari, 10 m, 23.xi.1963, P. Shanahan. (BPBM). GUADALCANAL: 1♂, 2♀ Tambalia, 30 km W Honiara, 25.v.1964, R. Straatman, Malaise trap (BPBM); SANTA ISABEL ISLAND: 1♀ Tatamba, 0-50 m, 2.ix.1964, R. Straatman, Malaise trap (BPBM); 1♂ Hageulu, 400-650 m, 13.ix.1964, R. Straatman (BPBM).

An immature ♂ in the BPBM labelled SW New Ireland, "Camp Bishop", 12 km up Kait R., 240 m, 11.vii.1956, E. J. Ford, possibly belongs to this species. Although the bluish metallic coloration is not developed, a bluish tinge is present and the anepisternite has a distinct yellow dorsal margin. Vein M_3 finishes well before the wing margin.

Some confusion exists over the use of the name *P. salomonensis* Lindner. Lindner (1937: 370) obviously intended describing the new species, *P. salomonensis*, but the description of *P. salomonensis* in the same paper (p. 393) is obviously referring to *P. isabelensis* Lindner, making *P. salomonensis* a junior synonym of *P. isabelensis*. Simultaneously Lindner introduced the epithet *salomonensis* for a subspecies of *P. longipennis* (Wiedemann).

James (1948: 196) raised *P. longipennis salomonensis* Lindner to specific rank, incorrectly placing Lindner's original *P. salomonensis* as a junior homonym of the *P.*



Figs 4-9. *Ptecticus* sp. (4-6) *P. tritus* n.n.: (4) cerci, proctiger and epandrium, dorsally; (5) hypopygium, laterally; (6) dististyle and hypandrium, ventrally; (7-9) *P. papuanus* (Bigot): (7) cerci, proctiger and epandrium, dorsally; (8) hypopygium, laterally; (9) dististyle and hypandrium, ventrally.

salomonensis originally used for a subspecific taxon.

The replacement name, *P. tritus*, is here proposed under article 57 (e) of the International Code of Zoological Nomenclature.

***Ptecticus papuanus* (Bigot)**
(Figs 7-9, 35)

Sargus papuanus Bigot 1879: 223.

Ptecticus papuanus (Bigot). — de Meijere, 1913: 319.

♂ *Head*. Width 1.4 height; frons at narrowest point 0.03-0.04 head width; relative width of frons: at narrowest point 1; at vertex 6.0-8.3; at antennae 4.7-7.0. Upper frons shining black with a row of fine proclinate hairs parallel to each eye margin; lower frons pale yellowish with indistinct fine reclinate pale hairs on ventral half. Ocellar hairs black. Face with long dense yellow hairs below antennal bases. Labellum pale yellowish. Antennae yellow, segment 1 with yellow hairs and a few black apical elements; arista black. *Thorax*. Orange, mesonotum and subscutellum with fine dense black setae, each arising from a small black tubercle; pleura with fine golden-yellow hairs, often sparsely covered. Pleurotergite with dense fine golden-yellow proclinate hairs. Posttegula orange, black-haired. Haltere orange; capitellum darkened. *Legs* orange. Fore and mid femora and fore tibia with golden-yellow hairs; hind femur blackish brown, black-haired. Mid tibia black-haired on basal half, golden-yellow distally; hind tibia and tarsus black, black-haired. Fore and mid metatarsi yellow-haired with some black elements along medial line; segment 2 black-haired dorsally, yellow ventrally; segments 3-5 completely black-haired. Pulvilli yellow. *Wing*. Uniformly brown, somewhat darker along costal margin; veins blackish. *Abdomen*. Lateral margin of tergite 1 with sparse, very long fine setae. Segments 1-3 orange, 4 and 5 black, all with black setae. *Hypopygium* (Figs 7-9) black, black-haired.

♀ : differs from ♂ as follows:

Head: Frons at narrowest point 0.07-0.09 width of head; relative widths of frons: at narrowest point 1; at vertex 2.0-2.2; at antennae 2.2-2.6. Lower frons and face orange-yellow, yellow haired. Antenna orange, yellow haired; arista black, orange on basal half. *Abdomen* (Fig. 35): Orange with variable black basal margins on tergites 2 and 3; tergites 4-6 black. Ovipositor brownish black, black-haired.

DIMENSIONS: body length, ♂ 11.5-12.2 mm, ♀ 10.5-11.2 mm; length of thorax, ♂ 4.1-4.6 mm, ♀ 4.0-4.2 mm; length of wing, ♂ 11.5-12.2 mm, ♀ 11.4-12.3 mm.

MATERIAL EXAMINED: NW NEW GUINEA: 1 ♂, 1 ♀ Bodem, 11 km SE Oerberfaren, 7-17.vii.1959, T.C. Maa (BPBM) (♂ with head missing); SE NEW GUINEA: 1 ♀ Kiunga, Fly River, 21-24.x.1957, W.W. Brandt (BPBM); 2 ♂ Kiunga, Fly River 35 m, viii.1969, J. & M. Sedlacek (BPBM).

The abdomen of this species appears very variable in coloration.

***Ptecticus complens* (Walker)**
(Figs 10-12, 36)

Sargus complens Walker 1859: 81.

Ptecticus complens (Walker). — van der Wulp, 1896: 49.

♂ *Head*: Width 1.4 height; frons at narrowest point 0.02 width of head; relative widths of frons; at narrowest point 1; at vertex 5.3; at antennae 6.3. Upper frons shining black

with a row of proclinate hairs parallel to each eye margin; lower frons pale yellowish with indistinct fine pale hairs. Ocellar hairs black. Face with a group of long pale hairs below antennal base. Antenna orange-yellow, golden haired; arista black. Labellum pale yellowish. *Thorax*: Orange-yellow. Mesonotum and subscutellum with fine dense black setae, each arising from a small black tubercle. Pleura with fine yellow hairs, often sparse. Pleurotergite with dense, yellow proclinate hairs. Posttegula orange, black-haired. Haltere yellow-brown, capitellum black-haired posteriorly. *Legs*: orange-yellow. Coxae, fore and mid femora and tibiae, and basal 2 segments of fore and mid tarsi yellow haired. Hind femur black-haired dorsally, yellow ventrally. Hind tibia and tarsus black, black-haired. Basal half of fore tibia black-haired ventrally. Fore tarsal segments 2-5 distinctly darkened, almost black, with black hairs. Mid tarsal segments similar, but paler in ground colour. *Wings*: hyaline. *Abdomen* (Fig. 36): orange-yellow. Basal two thirds of tergites with short black hairs, remainder yellow-haired. Tergites 2-5 with a black dorsal spot; tergite 6 orange-yellow, black-haired dorsally, yellow laterally. *Hypopygium* (Figs 10-12) black, black-haired.

♀: similar to ♂ except as follows:

Head: Relative widths of frons: at narrowest point 1; at vertex 1.5; at antennae 2.0. *Abdomen*: Tergite 7 brown; tergite 8 black, black-haired. Cerci black-brown, black-haired on outer margin, yellow apically on inner margin.

DIMENSIONS: body length, ♂ 11.3-11.8 mm, ♀ 10.8-11.2 mm; length of thorax, ♂ 3.6-3.8 mm, ♀ 3.8-4.1 mm; length of wing, ♂ 10.3-11.2 mm; ♀ 10.7-11.5 mm.

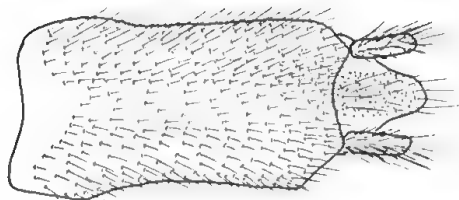
MATERIAL EXAMINED NW NEW GUINEA: 1♂ Waris, S of Hollandia, 450-500 m, 1-7.viii.1959, T.C. Maa (BPBM); 1♀ Cyclops Mountains: Ifar, 300 m, 4.xi.1959, J.L. Gressitt (BPBM); NE NEW GUINEA: 1♂ Dreikikir, Sepik District, 350-400 m, 23.vi.1961, J.L. & M. Gressitt (BPBM); 1♂ Imbia, nr. Maprik, 19.xii.1961, D.K. McAlpine (AM); 1♀ Karimui, 1080 m, 14.vii.1963, M. Sedlacek (BPBM); 1♀ Wau, Morobe District: 9.ix.1968, M. Sedlacek (BPBM); 1♀ 9.iv.1963, J. Sedlacek (BPBM); 1♀, 1.xii.1965, J. & M. Sedlacek (BPBM); 2♀, 1.xi.1965, P. Shanahan (BPBM); 2♀ Finschaffen, Huon Peninsula, 80 m, 13.iv.1963, J. Sedlacek (BPBM); 1♂, 1♀ May River, 100 m, 6-8.vi.1963, R. Straatman, light trap (BPBM); 1♂ 3.2 km S. Vanapa, Brown River Rd., 24-26.v.1965, W.A. Steffan, Malaise trap (BPBM); SE NEW GUINEA: 13♂, 18♀ Mamai Plantation, E of Port Glasgow, 3-16.ii.1965, R. Straatman, light trap (BPBM).

***Ptecticus gilvus* sp. n.**

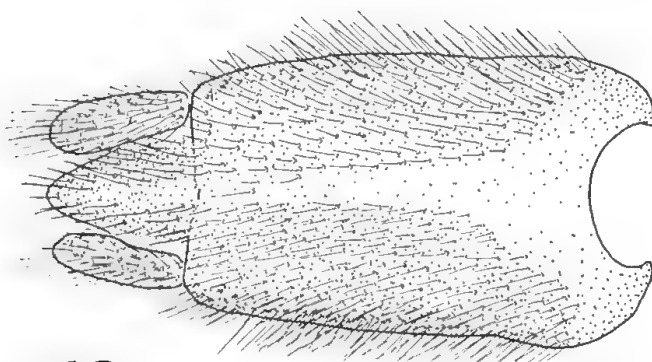
(Figs 13-15)

♂ *Head*: Height 0.7 width; frons at narrowest point 0.03 head width; relative widths of frons: at narrowest point 1; at vertex 6.4; at antenna 6.6. Upper frons shining black with a row of black proclinate hairs along each eye margin. Ocellar hairs black. Lower frons pale yellow, face pale yellow with a group of dark hairs below antennal bases. Antenna yellow, slightly darker than lower frons; yellow-haired; arista black, brownish basally. Labellum orange. *Thorax*: orange-yellow. Mesonotum and subscutellum with fine dense setae, yellow laterally, black medially; setae with basal tubercle orange-yellow. Pleura with sparse fine yellow hairs. Pleurotergite with long fine yellow proclinate hairs. Posttegula orange, black-haired. Haltere brownish (possibly discoloured). *Legs*: Orange-yellow. Coxae, femora, fore and mid tibiae and metatarsi yellow-haired, hind tibia black, becoming brownish orange apically; black-haired. Hind tarsus brownish orange, somewhat darker dorsally; hairs mostly orange-yellow, with some mixed black elements throughout. 4th and 5th tarsal segments mostly black-haired dorsally. Fore and mid tarsi

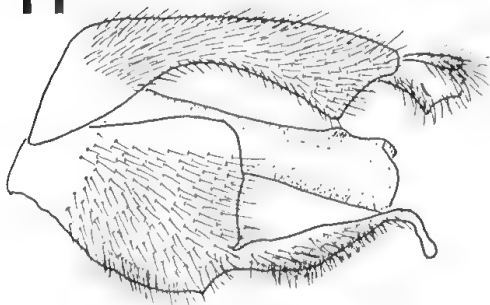
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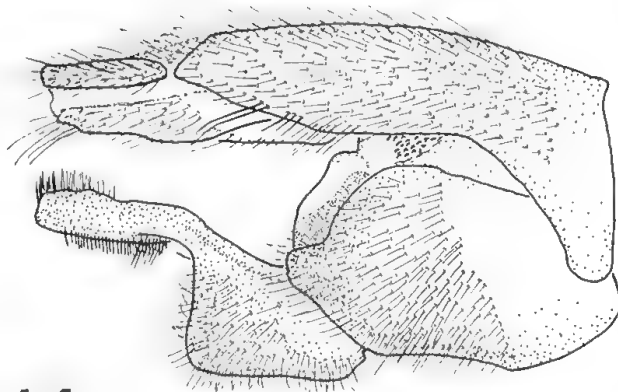
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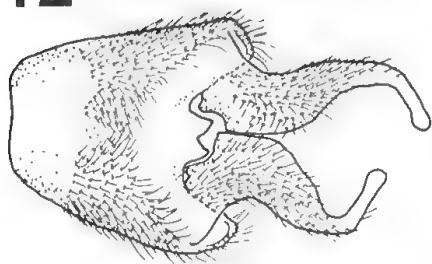
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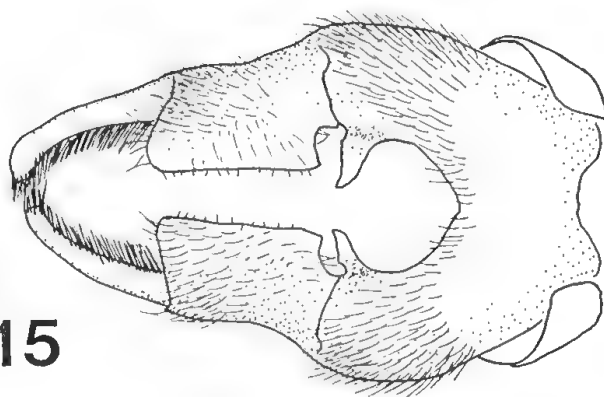
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12



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Figs 10-15. *Ptecticus* sp. (10-12) *P. complens* (Walker): (10) cerci, proctiger and epandrium, dorsally; (11) hypopygium, laterally; (12) dististyle and hypandrium, ventrally; (13-15) *P. gilvus* sp. n.: (13) cerci, proctiger and epandrium, dorsally; (14) hypopygium, laterally; (15) dististyle and hypandrium, ventrally.

mostly yellow-haired but with a few black elements distally, 5th segment mostly black-haired. Fore and mid empodium and pulvilli yellow; hind pulvilli brownish. *Wings*: Hyaline. Veins orange-brown. *Abdomen*: Orange-yellow, black setose, but golden-yellow along wide lateral margin and narrowly along posterior margin. Sternites with golden-yellow hairs. *Hypopygium* (Figs. 13-15): Epandrium brownish black, black setose; cerci and proctiger orange-yellow, black setose along basal margin, golden-yellow distally. Hypandrium, basistyle and dististyle deep orange-brown; dististyle almost black along edges.

♀. Unknown.

DIMENSIONS: body length, 13.0 mm; length of thorax, 4.2 mm; length of wing, 11.5 mm.

MATERIAL EXAMINED: *Holotype* ♂: NEW ZEALAND: Ridge above "Camp Bishop", 15 km up Kait R., 250-750 m, 13.vii.1956, J.L. Gressitt (BPBM).

The pale fore tarsus and terminalia distinguish this species from *P. quadrifasciatus* and *P. complens*.

***Ptecticus quadrifasciatus* (Walker)**

(Figs. 1, 2, 16-18, 37)

Sargus quadrifasciatus Walker 1861: 146.

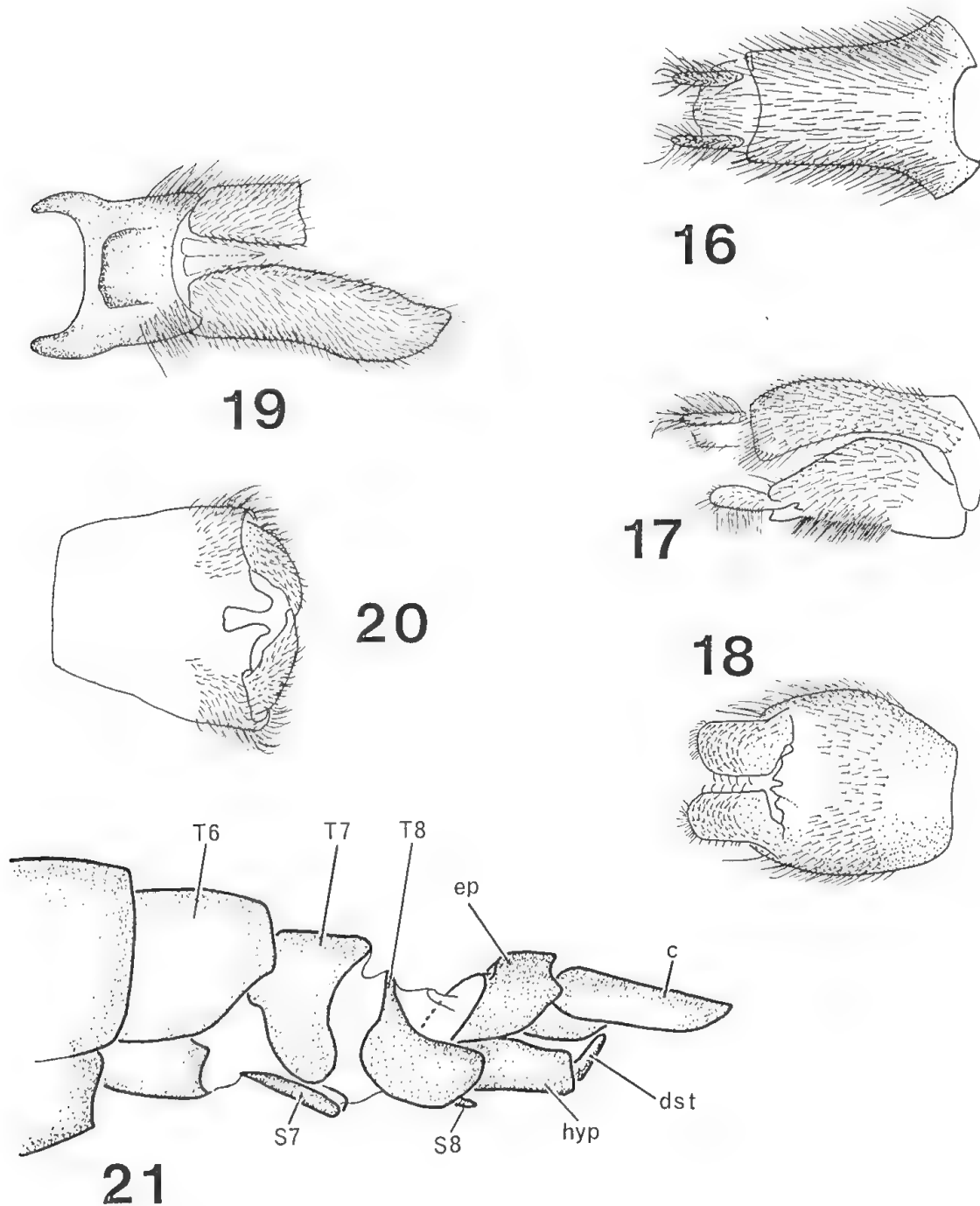
Ptecticus quadrifasciatus (Walker). — van der Wulp, 1896: 49.

Ptecticus albitarsus de Meijere 1913: 319, syn. n.

♂ *Head*: Width 1.3 height; frons at narrowest point 0.02-0.04 head width; relative widths of frons: at narrowest point 1; at vertex 4.2-9.0; at antennae 4.5-8.0. Upper frons shining black, with a row of fine erect black hairs bordering each eye margin; lower frons whitish, with indistinct white hairs. Face whitish, with a distinct group of long pale hairs below antennae, these denser than in *P. complens*. Lower eye margin with a row of whitish short fine hairs. Antenna orange-yellow, yellow-haired; arista black. Labellum white. *Thorax*: orange-yellow. Mesonotum and subscutellum with fine black setae, each arising from a small black tubercle. Pleura with fine golden-yellow hairs; pleurotergite with dense yellow proclinate hairs. Haltere yellow-orange, capitellum darkened with black hairs on posterior margin. Posttegula (Figs. 1, 2) orange, black-haired. *Legs*: yellow-orange. Coxae, fore and mid femora, tibiae and tarsi yellow-haired. Hind femur black-haired dorsally, yellow ventrally. Hind tibia and metatarsus black, black-haired. Mid tibia black-haired ventrally on basal half. Fore and mid tarsal segment 2 black-haired basally, segments 3-5 black-haired. Hind tarsal segment 2 white, sometimes black-haired basally; segments 3-5 white, white-haired; apical segment with some yellow and a pair of black hairs apically. Empodium yellow. *Wings*: suffused brownish. *Abdomen* (Fig. 37): Tergites mostly black-haired, yellow laterally. Tergite 1 with a blackish brown basolateral spot; tergites 2-5 black basally; tergite 6 orange-yellow, black-haired. *Hypopygium* (Figs 16-18) black, black-haired.

♀: similar to ♂ except as follows:

Head: Width 1.4 height; frons at narrowest point 0.08 head width; relative widths of frons: at narrowest point 1; at vertex 2.0-2.1; at antennae 2.1-2.2. *Legs*: Tarsal segments 4 and 5 on fore and mid legs black haired, not as densely as in ♂; segment 3 apically black-haired. *Abdomen*: Tergite 6 deep orange yellow; segments 7 and 8 black, black-haired. Cerci black-haired, yellow apically.



Figs 16-21. *Ptecticus* sp. (16-18) *P. quadrifasciatus* (Walker): (16) cerci, proctiger and epandrium, dorsally; (17) hypopygium, laterally; (18) dististyle and hypandrium, ventrally; (19-21) *P. isabelensis* Lindner: (19) cerci, proctiger and epandrium, dorsally; (20) dististyle and hypandrium, ventrally; (21) hypopygium laterally. Notation as Fig. 3. S. sternite.

DIMENSIONS: body length, ♂ 12.4-15.3 mm, ♀ 8.1-10.5 mm; wing length, ♂ 11.8-13.7 mm, ♀ 7.5-9.9 mm; length of thorax, ♂ 3.3-3.8 mm, ♀ 2.9-3.1 mm.

MATERIAL EXAMINED: NW NEW GUINEA: 1♂ Kota Nica, Hollandia, 27.vii.1956, R. T. Simon Thomas (BPBM); 1♂ Bodem, 11 km SE Oerberfaren, 100 m, 7-17.vii.1959, T. C. Maa (BPBM); 1♂ Kota Baru, Hollandia, 25-28.vi.1962, N. Wilson (BPBM); 1♂ Genjam, 40 km W Hollandia, 100-200 m 1-10.iii.1960, T. C. Maa (BPBM); 1♂ Eramboe, 29.i.1960, T. C. Maa (BPBM); Biak Island: 3♂ 27-29.v.1959, T. C. Maa (BPBM); 1♀ 18.ii.1963, R. Straatman, ex Malaise trap (BPBM); 1♂ 17.vii.1957, D. E. Hardy (BPBM). SW NEW GUINEA: 1♂ Alkmaar, 2.ii.1910, (anon.) (ZMA). NE NEW GUINEA: 1♂ Krisa, Vaimo, iv.1939, L. E. Cheesman (SAM); 1♂ Imbia, nr Maprik, 22.xii.1963, D. K. McAlpine (AM); 13♂ Umboi Is., approx. 8 km WNW Lab Lab, 300 m, 8-19.ii.1967, Samuelson and Colman (BPBM); 1♀ Finisterne Range, Saidor: Sibong Village, 6-16.vi.1958, W. W. Brandt (BPBM); 1♂ Amok, 165 m, 6.i.1960, T. C. Maa (BPBM); 1♂ Huon Peninsula, Finschaffen, 80 m, 16.iv.1963, J. Sedlacek, ex Malaise trap (BPBM); 1♀ May River, 100 m 8.vi.1963, R. Straatman, light trap (BPBM). SE NEW GUINEA: 2♂ Daradae Plantation, 80 km N Port Moresby, 500 m, 7.ix.1959, T. C. Maa (BPBM); 1♀ Brown River, nr Port Moresby, 10 m, 5.x.1958, J. L. Gressitt (BPBM); 1♂ Lake Murray, 17.xi.1963, D. K. McAlpine (AM); NEW IRELAND: 1♂ 50 km from Kavieng, 50-130 m, 3.vii.1959, J. L. Gressitt (BPBM); 1♂ Gilingil Plantation, SW New Ireland, 6.vii.1956, E. J. Ford (BPBM); 1♂ Kavieng, 6.i.1971, G. Daniels (GD). AUSTRALIA: north Queensland: 1♂, 8♀, Middle Claudie River, 25.ix.-21.xi.1974, G. Daniels (GD); 1♂ Claudie River, 5 ml W Mt Lamond, 24.xii.1971, McAlpine and Holloway (AM).

NOTES ON STATUS: De Meijere described *P. albitarsis* from Dutch New Guinea without making a comparison with *P. quadrifasciatus*, although he compared it with several not so closely allied species. In Brunetti's 1923 key to species he separates *P. albitarsis* from *P. quadrifasciatus* on the coloration of the abdomen, whilst in the text distinguishes *P. albitarsis* from *P. australis* Schiner on the dark brown coloration of the mesonotum. An examination of the ♂ holotype of *P. albitarsis* shows it to agree well in most characters with *P. quadrifasciatus*. Some degree of variation in the black coloration of the tergites exists, but the terminalia agree in all respects. The type of *P. albitarsis* has become very greasy, thus producing a dark brown thorax and abdomen. Another ♂ specimen examined, identified as *P. albitarsis* by de Meijere and in excellent condition agrees in all respects with *P. quadrifasciatus*.

***Ptecticus isabelensis* Lindner**

Figs. 19-21, 38, 39)

Ptecticus isabelensis Lindner 1937: 373.

Ptecticus salomonensis Lindner. — James 1948: 197.

♂ **Head:** Width 1.3 height; frons at narrowest point 0.05 head width; relative widths of frons: at narrowest point 1; at vertex 2; at antennae 3.3. Upper frons shining black, black-haired along each eye margin. Lower frons and face whitish. Face with black hairs below antennal bases. Antenna orange; segments 1 and 2 black-haired; arista black. Labellum yellow. **Thorax:** orange. Mesoscutum, scutellar margin and subscutellum yellow setose, each seta arising from a small black tubercle. Scutellar disc black-setose. Pleura yellow-haired. **Legs:** Coxae yellow; fore and mid coxae yellow-haired, hind coxa black-haired. Fore and mid femora yellow, yellow-haired; hind femur brownish anteriorly, yellowish apically, black-haired along dorsal and ventral margin except subapically, otherwise yellow-haired. Fore and mid tibiae yellow, yellow-haired on entire ventral surface, black antero-dorsally. Hind tibia and metatarsus black, black-haired;

tarsal segments 2, 3 and 4 ventrally white with white hairs; segment 4 darkened dorsally with black hairs; segment 5 deep brown, mostly with brown-black hairs. Fore and mid tarsi yellow-brown, black-haired dorsally, yellow ventrally. *Wings*: suffused brownish. *Abdomen* (Figs. 38, 39): Tergites 1-3 black, narrowly orange on apical margin, black-haired; lateral margin of tergites 1 and 2 orange; tergites 4-7 completely black, black-haired. Posterolateral corners of tergites 2 and 3 yellow-haired. Sternite 1 brownish basally, apically yellow; sternite 2 yellow, apical half brownish and posterior margin narrowly yellow; sternite 3 mostly deep brownish, yellowish on extreme margin; sternites 4-7 black. *Hypopygium* (Figs 19-21) black, black-haired.

DIMENSIONS: body length, 12.5 mm; length of thorax, 4.0 mm; length of wing, 11.2 mm.

MATERIAL EXAMINED: SOLOMON ISLANDS: 1♂(no date), G. M. Woodford, (AM); 1♂, 1924, W. W. Froggatt, (ANIC).

Related to *P. quadrifasciatus*, distinguished by the dark abdomen and the hind tarsal segments 2-4 being white. The AM specimen agrees well with Lindner's description. Another♂ in ANIC agrees with Lindner's description in all points except for the pattern on the abdomen, but appears to have no apparent differences in hypopygia with the AM specimen. Presumably the patterning of the abdomen is variable. The abdomen of the ANIC specimen differs from the AM specimen as follows: abdomen orange-yellow, tergites 2 and 3 with a medial black central band, surrounded by orange-yellow; tergite 4 mostly black with orange-yellow lateral and distal margins (see fig. 39).

***Ptecticus spatuloides* sp. n.**
(Figs 22-24)

♂ *Head*: Width 1.3-1.5 height; frons at narrowest point 0.04-0.1 head width; relative widths of frons: at narrowest point 1; at vertex 1.3-2.8; at antennae 2.1-4.6. Upper frons shining black, with a row of proclinate hairs parallel to each eye margin. Lower frons orange with short yellow hairs on ventral two thirds. Ocellar hairs black. Face yellow-orange with a group of yellow hairs below antenna. Antenna yellow, yellow-haired; arista black. Labellum reddish brown. *Thorax*: Orange-yellow. Vestiture of mesoscutum golden yellow, with black elements medially, extending to scutellar suture. Pleura yellow-haired. Posttegula orange-yellow, with golden-yellow hairs. Haltere orange-yellow. *Legs*: orange-yellow. Coxae, femora and fore and mid tibia yellow-haired. Hind tibia black, black-haired. Fore tarsus yellow-haired with a few black elements dorsally on apical third; segments 2-5 black-haired; segments 3 and 4 with ground colour deep brown, especially so on 4th. Mid tarsus similar, metatarsus with black-hairs on apical two thirds. Hind tarsus black-brown, black-haired. *Wings*: Tinted deep brown; costal margin to apex of R_5 and including second basal cell almost black. *Abdomen*: orange-yellow; vestiture entirely golden-yellow. Segments 3 and 4 wider than thorax and almost twice as wide as first segment, giving abdomen a distinctly spatulate appearance. *Hypopygium* (Figs 22-24) orange-yellow; epandrium black-haired.

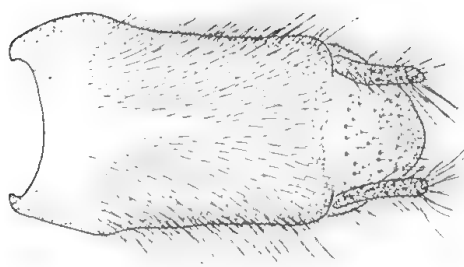
♀: similar to ♂ and differing as follows:

Head: Width 1.4-1.5 height; frons at narrowest point 0.06-0.09 width of head; relative widths of frons: at narrowest point 1; at vertex 1.2-2.1; at antennae 2.3-3.4. *Thorax*: Vestiture completely golden-yellow. *Legs*: Fore and mid metatarsi completely yellow-haired. Ovipositor orange, yellow-haired.

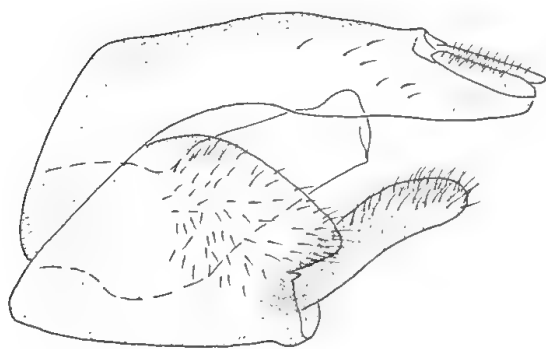
DIMENSIONS: body length, ♂ 10.5-12.8 mm, ♀ 10.5-11.5 mm; length of thorax, ♂ 3.8-5.1 mm, ♀ 3.5-4.2 mm; length of wing, ♂ 10.1-13.2 mm, ♀ 11.6-12.1 mm.



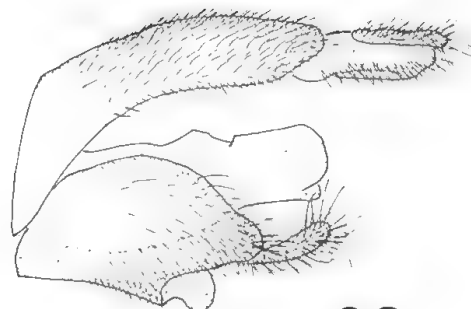
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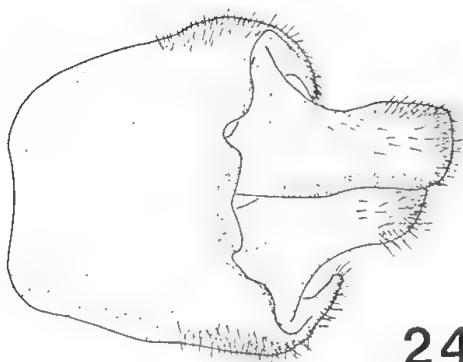
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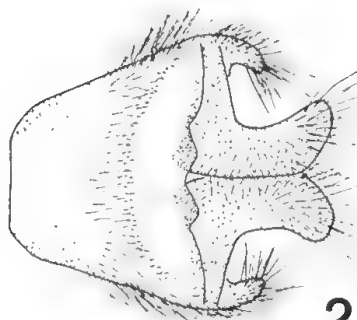
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Figs 22-27. *Petecticus* sp. (22-24) *P. spatuloides* sp. n.: (22) cerci, proctiger and epandrium, dorsally; (23) shypopygium, laterally; (24) dististyle and hypandrium, ventrally; (25-27) *P. ferrugineus* (Doleschall): (25) cerci, proctiger and epandrium, dorsally; (26) hypandrium, laterally; (27) dististyle and hypandrium, ventrally.

MATERIAL EXAMINED: *Holotype* ♂: NEW BRITAIN: St. Pauls, Baining, Gazelle Peninsula, 300 m, 9.ix.1955, J. L. Gressitt (BPBM).

Paratypes: NEW BRITAIN: 2 ♂, 1 ♀ Upper Warangai, Gazelle Peninsula, 250-600 m, 28-30.xi.1962, J. Sedlacek (BPBM); 1 ♀ same data as holotype except 8.ix.1955 (BPBM).

The hypopygium appears to be partly recessed into the 5th segment. One ♂ has its frons wider than that of the widest frons.

The shape of the abdomen and the ♂ terminalia separates this species from *P. ferrugineus*.

***Ptecticus ferrugineus* (Doleschall)**
(Figs 25-28)

Sargus ferrugineus Doleschall 1858: 83.

Ptecticus ferrugineus (Doleschall): — van der Wulp 1898: 410.

Ptecticus atritarsus Edwards 1915: 396. Synonymized by Brunetti 1923: 145.

Related to *P. queenslandicus* and differing from the description given for that species as follows:

♂ *Head*: Height 0.71-0.78 width. Frons at narrowest point 0.05 width of head; relative widths of frons: at narrowest point 1; at vertex 2.6-3.6; at antennae 3.8-4.2. Lower frons orange, pale yellow or white. *Thorax*: orange-yellow. Mesoscutum with short yellow setae, a few scattered black elements medially. Scutellum and subscutellum black setulose. Haltere yellowish; capitellum darkened apically, yellow-haired posteriorly. *Legs*: Coxae, femora, tibiae and 2 basal tarsal segments of fore and mid legs yellow-haired. Hind femur yellow-haired with a few black dorsal elements. Hind tibia and tarsus deep brown. Tarsal segments 3-5 on fore and mid legs black-haired, sometimes yellow-haired with only a few black elements apically on each segment. *Wings*: hyaline. Anterior branch of *M* between origin and *r-m* crossvein convex, *r-m* being at middle of discal cell (inset, Fig. 28). Submarginal cell sometimes clouded brown. *Abdomen*: Pale orange-yellow. Tergites with variable black setae dorsally, often absent. *Hypopygium* (Figs 25-27): orange-yellow, or pale yellow, with black setae.

♀: similar to ♂ except as follows:

Head: Height 0.67-0.71 width. Frons at narrowest point 0.08-0.1 width of head; relative widths of frons: at narrowest point 1; at vertex 1.5-1.9; at antennae 2.0-2.5.

DIMENSIONS: body length, ♂ 8.5-12.5 mm, ♀ 9.7-12.8 mm; length of thorax, ♂ 2.9-4.9 mm, ♀ 3.5-4.5 mm; length of wing, ♂ 7.5-12.3 mm, ♀ 10.1-12.5 mm.

MATERIAL EXAMINED: NW NEW GUINEA: 2 ♂, 2 ♀ Hollandia, 8.iii.1958, R.T. Simon Thomas (AM); 1 ♂ Hollandia-Binneh, 20-50 m, 27.vii.1959, T.C. Maa (BPBM); 1 specimen with abdomen missing, same locality, 100 m, 2.xi.1958, J.L. Gressitt (BPBM); 1 ♀ Wisselmeren, Enarotodi, 1800-1900 m, 27.vii.1962, J. Sedlacek (BPBM). NE NEW GUINEA: 1 ♂, 1 ♀ Lae, vii.1944, F.E. Skinner (BPBM); 1 ♀ Bulolo Gorge, c 800 m, 19.xii.1961, L.W. Quate (BPBM); 3 ♀ Maprik, 150 m, 29.xii.1959-17.i.1960, T.C. Maa (BPBM); 1 ♀ Bainyik, 21.xii.1963, D.K. McAlpine (AM); 2 ♀ Munum Waters, 15 ml W of Lae, 14 and 16.i.1971, G. Daniels (GD). 1 ♂ Bulolo Riv, 800 m, 30.iii.1970, N. Gough (BPBM); 2 ♂, May River, 6 and 8.vi.1963, R. Straatman (BPBM); 1 ♂ Bubia, nr Lae, 26.vii.1957, J.H. Ardley (BPBM). SE NEW GUINEA: 1 ♂ Milne Bay, 14-28.ii.1969, J. Sedlacek, (BPBM); 1 ♂ Mamai Plantation, E of Port Glasgow, 150 m, 10.ii.1965, R.

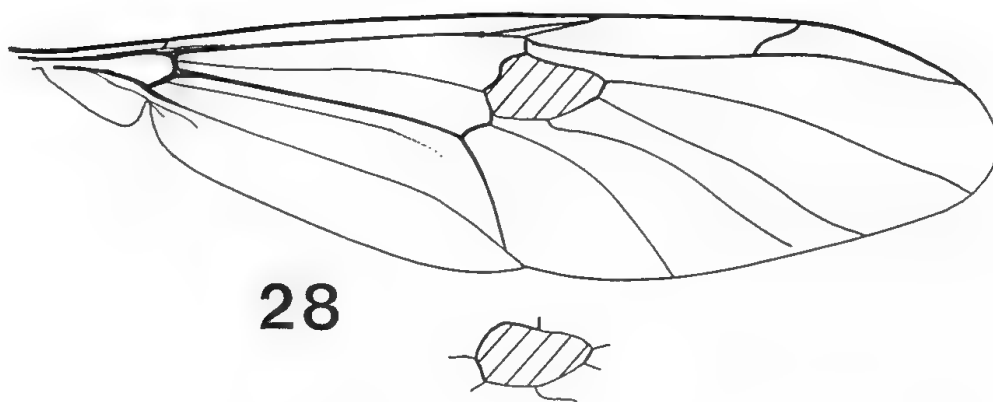


Fig. 28. *P. queenslandicus* sp. n.: wing. Insert shows discal cell of *P. ferrugineus* (Doleschall).

Straatman (BPBM); 1 ♂ Kiunga, Fly River, 21-24.xi.1957, W.W. Brandt (BPBM); 1 ♂ Mori River, Cape Rodney area, ix.1969, R. Pullen (ANIC); 1 ♂ Buna to Saputa, 5.vi.1921, E.O. Pockley (AM); 4 ♂ Mt. Lamington, v.1927, C.T. McNamara (AM); 1 ♂ Popondetta, 21.i.1971, G. Daniels (GD); BISMARCKS: NEW IRELAND: 1 ♂ Kandan, 1.i.1960, W.W. Brandt (BPBM); MANUS ISLAND: 3 ♂; 3 ♀, Los Negros Island, banana bait, 28.iii.1974, D.P. Sands (ANIC).

***Ptecticus queenslandicus* sp. n.**

(Figs 28-31)

♂ *Head*: Height 0.7 width; frons at narrowest point 0.03-0.05 head width; relative widths of frons: at narrowest point 1; at vertex 3.2-4.3; at antennae 4.0-5.0. Lower frons shining, pale yellow. Upper frons shining black with a row of black proclinate hairs along eye margin. Ocellar hairs black. Face pale yellowish with a group of pale hairs below antennal bases. Antenna yellow; arista black. Labellum pale yellow. *Thorax*: orange-yellow. Mesonotum and subscutellum mostly with fine dense yellow setae, some black elements medially, each arising from a small orange-yellow tubercle. Pleura with sparse fine yellow hairs. Pleurotergite with longer dense fine yellow proclinate hairs. Posttegula orange-yellow, yellow-haired. Haltere yellowish; capitellum with a few black hairs posteriorly. *Legs*: Orange-yellow. Coxae, femora, fore and mid tibiae and 2 basal tarsal segments yellow-haired. Hind tibia and tarsus completely black, black-haired. Fore and mid tarsi with segments 3-5 black-haired. *Wing* (Fig. 28): Hyaline, indistinctly clouded apically; veins black. Anterior branch of *M* between origin and *r-m* crossvein sinuous. *Abdomen*: Orange-yellow, more richly coloured than thorax. Tergites 2-5 with a variable medio-basal area of fine black setae, laterally yellow setose; tergite 6 yellow setose. Sternites yellow-haired. *Hypopygium* (Figs 29-31): yellowish brown, mostly covered with black setae.

♀: differs from ♂ as follows:

Head: Height 0.69-0.74 width; frons at narrowest point 0.08-0.1 head width; relative widths of frons: at narrowest point 1; at vertex 1.4-2.0; at antennae 1.8-2.6. *Legs*: Fore and mid tarsi with black hairs on segments 3-5 less dense and shorter apically. *Abdomen*: Ovipositor yellow-brown, with few setae.

DIMENSIONS: body length, ♂ 8.7-10.5 mm, ♀ 9.0-11.2 mm; length of thorax, ♂ 2.7-3.3 mm, ♀ 2.8-4.1 mm; wing length, ♂ 7.9-9.0 mm, ♀ 8.2-10.1 mm.

MATERIAL EXAMINED: *Holotype* ♂: AUSTRALIA, north Queensland: Middle Claudie River, 29.ix.1974, G. Daniels (AM).

Paratypes: 3 ♂, 21 ♀ same data except 13.ix.-1.xi.1974 (GD); 1 ♂ Cape Weymouth, 23.iv.1931, L. Wassel (AM); 1 ♂ 2 ml N Tully River bridge, Cardstone-Ravenshoe Rd, 16.i.1967, McAlpine and Holloway (AM); 1 ♂ Mulgrave River, 4 ml W Gordonvale, 2.i.1967, D.K. McAlpine (AM); 1 ♀ Crystal Cascades, near Cairns, 27.xii.1964, C.F. Ashby (ANIC).

***Ptecticus amplior* sp. n.**

(Figs 3, 32, 33, 41)

♂ *Head*: Height 0.72 width. Frons at narrowest point 0.05 head width; width of frons at vertex and antennal level subequal, only slightly wider than at level of lower margin of upper frons. Eyes bluish in life. Upper frons shining black, with a row of yellow hairs parallel to each eye margin and with a few scattered elements between. Ocellar hairs black. Vertex behind ocellarium orange-yellow. Lower frons yellow with golden-yellow hairs medially on lower half. Face yellow with fine golden-yellow hairs below antennae. Antenna orange-yellow; arista black. Labellum yellow. *Thorax*: brownish yellow. Mesoscutum yellow-setose anteriorly, black-setose posteriorly. Scutellum black-setose; subscutellum with yellow setulae, longer than in other species. Hairs on pleura yellow, not as fine as other species. Posttegula orange-yellow, yellow-haired. Haltere yellow; capitellum slightly darkened and with golden-yellow hairs anteriorly and posteriorly. *Legs*: orange-yellow. Coxae, femora, fore and mid tibiae and tarsi yellow-haired. Hind tibia black with black hairs, a few yellow hairs basally. Hind metatarsus blackened basally, becoming orange-yellow apically, black-haired basally, becoming golden-yellow apically; segments 2-5 yellow, with golden-yellow hairs and some black elements apically on each segment. Fore and mid tarsal segments 3-5 black-haired dorsally. *Wings*: Basally yellowish, apically brownish, especially in costal area. *Abdomen* (Fig. 41): yellow-orange, slightly more deeply coloured than thorax. Tergites 2-6 with black setulae on most of dorsal surface, some specimens with a very variable deep brownish band on dorsal surface. *Hypopygium* (Figs 3, 32, 33): orange-yellow, yellow-haired.

♀: similar to ♂.

DIMENSIONS: Body length, ♂ 16.3-17.0 mm, ♀ 11.8-14.8 mm; length of thorax, ♂ 5.2-5.4 mm, ♀ 3.6-4.8 mm; length of wing, ♂ 15.0-16.0 mm, ♀ 10.7-13.6 mm.

MATERIAL EXAMINED: *Holotype* ♂: AUSTRALIA, north Queensland: Middle Claudie River, 11.x.1974, G. Daniels (AM).

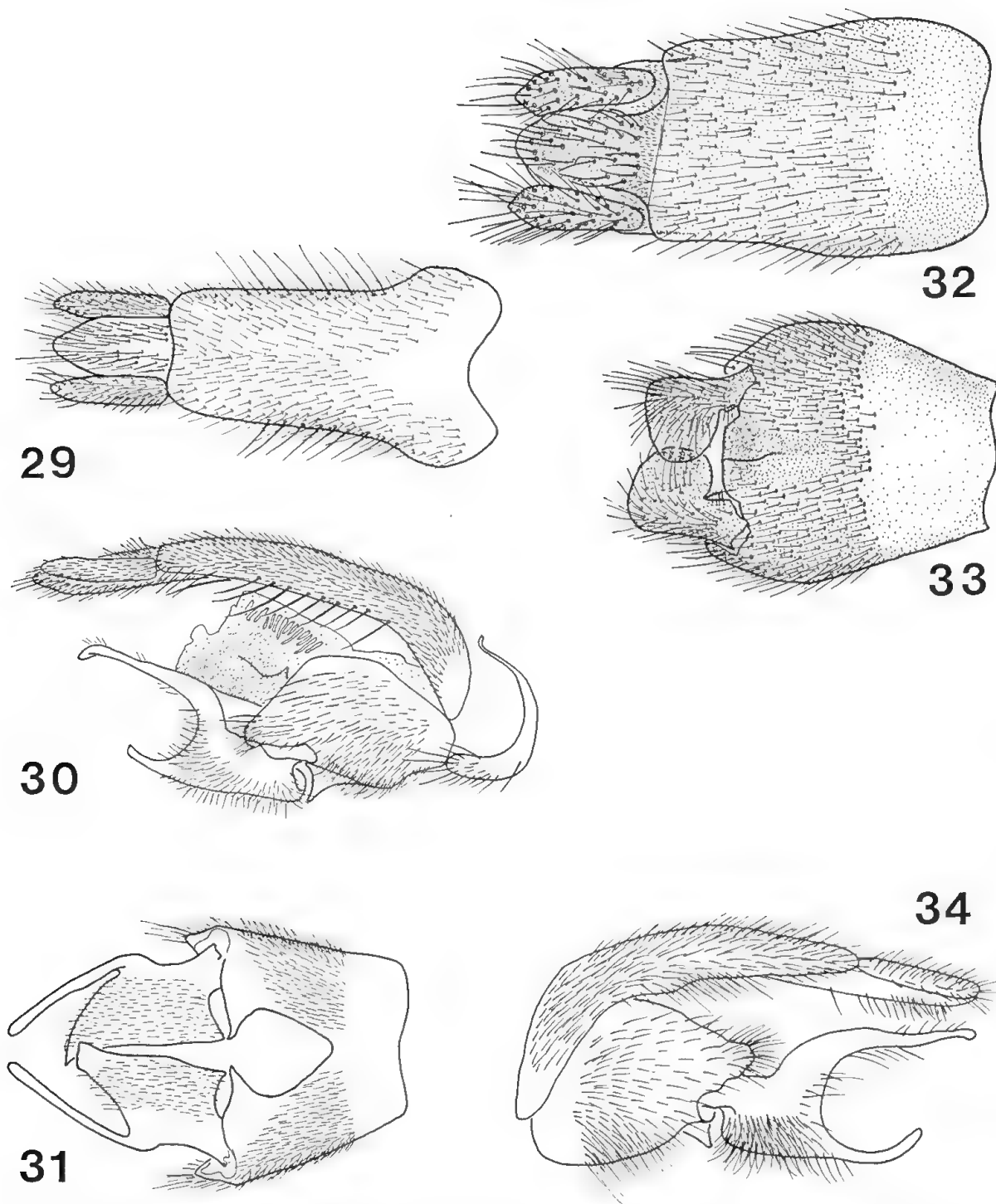
Paratypes: NW NEW GUINEA: 1 ♂ Ifar, Cyclops Mountains, 300-500 m, 28-30.vi.1962, J.L. Gressitt (BPBM); NE NEW GUINEA: 1 ♀ Lae, 27.vi.1956, E.J. Ford Jnr. (BPBM); SE NEW GUINEA: 1 ♀ Mamai Plantation, E of Port Glasgow, 150 m, 3.ii.1965, R. Straatman (BPBM); NORMANBY IS: 1 ♀ Wakaiuma, Seva Bay: 1-10.xii.1956, W.W. Brandt (BPBM); 1 ♂, 11.xi.1956, 1 ♂, 25-30.x.1956, (BPBM); WOODLARK IS: Kulumadau Hill, 1 ♀, 25.ii.1957, 1 ♀, iii.1957, 1 ♀, 27-30.iv.1957, W.W. Brandt (BPBM).

This species is easily recognised by its wing coloration, large size and reduced black setae of the fore and mid tarsi.

***Ptecticus helvolus* sp. n.**

(Fig. 34)

This species agrees very well with the description given for *P. ferrugineus*. However, it is distinguished by the yellowish upper frons and the male terminalia (Fig. 34), the



Figs 29-34. *Ptecticus* sp. (29-34) *P. queenslandicus* sp. n.: (29) cerci, proctiger and epandrium, dorsally; (30) hypopygium, laterally; (31) dististyle and hypandrium, ventrally; (32, 33) *P. amplior* sp. n.: (32) cerci, proctiger and epandrium, dorsally; (33) dististyle and hypandrium, ventrally; (34) *P. helvolus* sp. n.: hypopygium, laterally.

terminalia being similar to *P. queenslandicus*. The shape of the discal cell is also similar to *P. queenslandicus*. The hind tibia is distinctly brown, with black hairs and the hind tarsus is yellow (yellow-brown in 1 specimen), yellow-haired anteriorly, black-haired posteriorly, the third and fourth segments are distinctly brown.

♂ *Head*: Height 0.73 width. Frons at narrowest point 0.03 head width; relative widths of frons: at narrowest point 1; at vertex 5.0; at antennae 5.1.

DIMENSIONS: Length of body, 10.0 mm; length of thorax, 3.5 mm; length of wing 10.5 mm. The wings are badly crumpled, the above dimension being estimated.

MATERIAL EXAMINED: *Holotype* ♂: NE NEW GUINEA: Torricelli Mtns, Nengian Village, 17-24.xi.1958, W. W. Brandt (BPBM).

Other material examined: NE NEW GUINEA: 1 ♂ Buba, near Lae, 27.v.1957, J. H. Ardley (BPBM).

The Buba specimen has the abdomen marked similarly to fig. 36 (*P. complens*).

A ♀ from Sio, north coast of New Britain (BPBM) doubtfully belongs to this species. The frons is yellow-brown, and the hind tibia is brownish basally, yellow-brown apically, but differs in having the wing veins completely yellow with some greyish suffusion apically.

***Ptecticus substitutus* sp. n.**
(Figs 42-44)

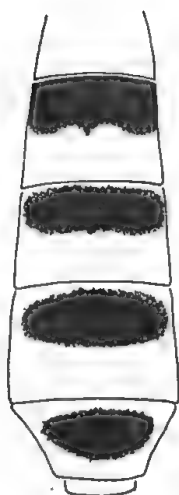
Ptecticus repensans (Walker). — James 1948: 197 (misidentification).

♂ *Head*: Height 0.7 width. Frons at narrowest point 0.02-0.07 head width; relative widths of frons: at narrowest point 1; at vertex 8.5-12; at antennae 8.5-10. Lower frons shining pale yellow. Upper frons shining black tending to become brown around ocellar tubercle and with yellow proclinate hairs, being rather dense on lower half and sparse and in a single row parallel to eye margin on upper half. Ocellar hairs yellow. Face shining pale yellow with a group of yellow hairs just below antennal bases. *Antennae*: yellow, yellow-haired; arista black. *Thorax*: orange-yellow to yellow. Mesonotum laterally with fine short dense yellow setae, medially and submedially black-setose. Subscutellum with fine dense golden-yellow setae. Pleura with sparse fine yellow hairs. Pleurotergite with longer fine dense golden-yellow proclinate hairs. Posttegula yellow to orange, yellow-haired. Haltere yellowish, capitellum sometimes with a few black hairs posteriorly. *Legs*: Orange-yellow to yellow. Coxae, femora, fore and mid tibiae and 2 basal tarsal segments with golden-yellow hairs. Hind tibia brown to black, black-haired. Hind metatarsus yellow to white, black to brown-haired on basal third. Hind tarsal segment 2 yellow to white with a dorsal patch of black hairs apically. Segments 3-5 on all tarsi deep brown to black, black-haired. Hind tarsal segment 3 occasionally white to yellow, white to yellow-haired. *Wings*: Yellowish hyaline; veins yellow to yellow-orange. Microtrichia yellowish. Macrotrichia and setae on veins black. Anterior branch of *M* between origin and *r-m* crossvein sinuous. *Abdomen*: Yellow to orange-yellow, golden-yellow setose. Tergites 1-5 with a variable central area of black setae on medial line. *Hypopygium* (Figs 42-44): black, black-setulose, cerci and proctiger orange-yellow with golden-yellow hairs.

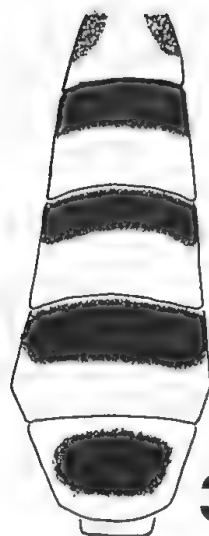
♀: differs from ♂ as follows:



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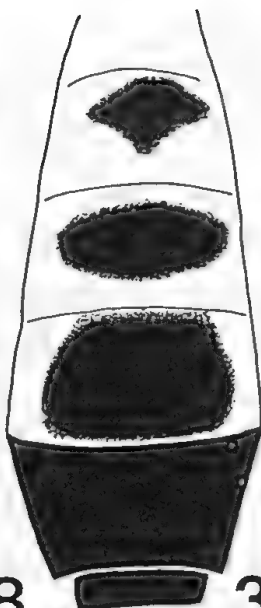
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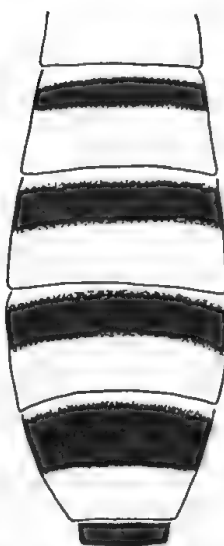
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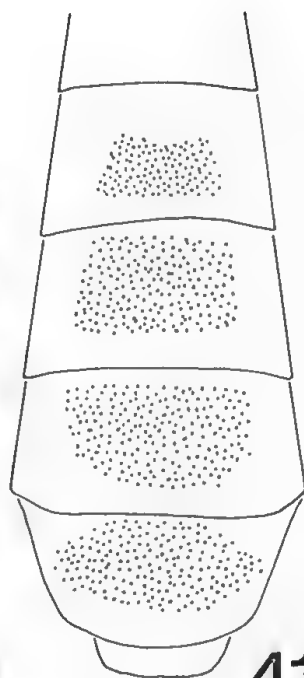
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Figs 35-41. Abdominal markings of *Ptecticus* sp. (35) *papuanus* (Bigot); (36) *complens* (Walker); (37) *quadrifasciatus* (Walker); (38, 39) *isabelensis* Lindner; (40) *eximius* sp. n.; (41) *amplior* sp. n.

Head: Height 0.7-0.75 width. Frons at narrowest point 0.07 head width. Relative widths of frons: at narrowest point 1; at vertex 1.6; at antennae 2.5. Upper frons with golden-yellow hairs dorsally along eye margin and on entire lower half. Ocellar hairs yellow. Lower frons brown. Antennae yellow to yellow-brown; arista black.

DIMENSIONS: Body length, ♂ 11.5-15.0 mm; ♀ 12.0-14.5 mm; length of thorax, ♂ 3.8-4.8 mm; ♀ 4.1-4.5 mm; wing length, ♂ 10.5-13.5 mm; ♀ 11.5-12.4 mm.

MATERIAL EXAMINED: *Holotype* ♂: SOLOMON ISLANDS: BOUGAINVILLE: Kukugai Village, 150 m, xii.1960, W. W. Brandt (BPBM).

Paratypes: SOLOMON ISLANDS: BOUGAINVILLE: 2 ♀ Buin, 27.xii.1970, G. Daniels (GD); 1 ♂ Kieta, 26.xi.1959, T. C. Maa (BPBM). SANTA ISABEL IS: 1 ♂ Tantamba 0-50 m, 14.ix.1964, R. Straatman (BPBM). NEW GEORGIA GROUP: 1 ♀ NE end of Rendova Island, 18.vii.1959, J. L. Gressitt (BPBM). GUADALCANAL IS: 1 ♂ Paripao 22.v.1960, C. W. O'Brien (BPBM); 1 ♀ Roroni, 35 km E of Honiara, 10 m, light trap, 18.v.1964, R. Straatman (BPBM); 1 ♂, 2 ♀ Betikama River, ix.1960, W. W. Brandt (BPBM). MALAITA IS: 1 ♀ Dala, light trap, 25.vi.1964, R. Straatman (BPBM). FLORIDA GROUP: 1 ♂ Gairava, 14.ix.1960, C. W. O'Brien (BPBM); 1 ♂, 1 ♀ Halletta, Nggela Is, 250 m, Malaise trap, 17.x.1964, R. Straatman (BPBM); 1 ♂, 1 ♀ Gairava M'boli passage, Big Nggela, 13.ix.1960, C. W. O'Brien (BPBM).

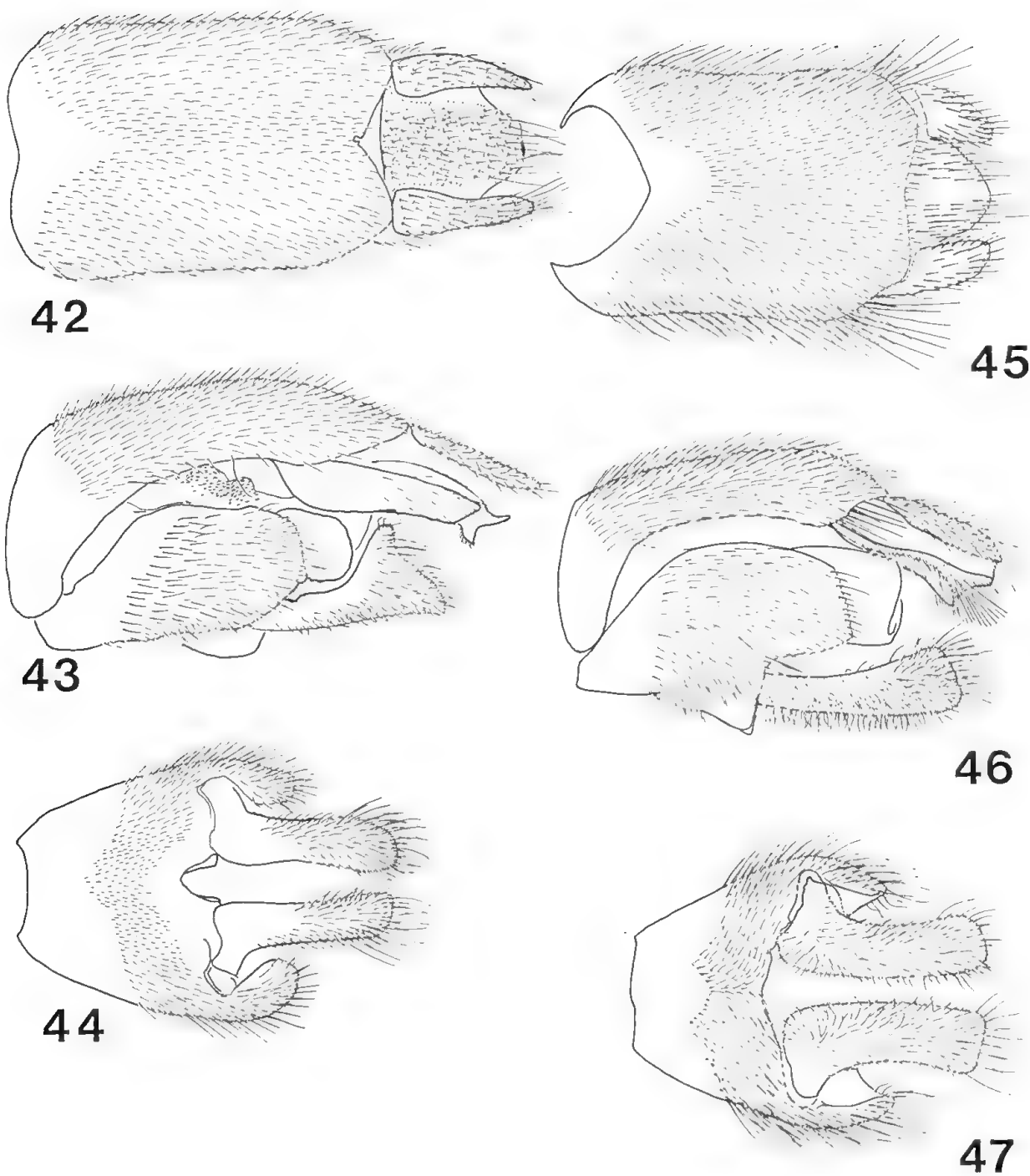
A camera lucida drawing of the discal cell of the type specimen of *P. repensans* kindly supplied by Mr K. G. V. Smith places *P. repensans* in the group with *r-m* opposite *M*₃. *P. substitutus* differs from *P. repensans* in having *r-m* proximal to *M*₃. Also the hind tarsus of *P. substitutus* differs in being black with black setae. Unfortunately the genitalia of the type are missing and a comparison is not possible.

***Ptecticus eximius* sp. n.**
(Figs 40, 45-47)

Head: Height 0.75 width; frons at narrowest point 0.02 head width; relative widths of frons: at narrowest point 1; at vertex 7; at antennae 10. Upper frons shining black with a row of yellowish proclinate hairs along each eye margin. Ocellar hairs yellowish, lower frons pale yellow, face pale yellow with a group of yellow hairs below antennal bases. Antennae orange-yellow; arista brownish. Labellum orange-yellow. *Thorax:* Orange-yellow. Mesonotum and subscutellum with fine dense black setae; alveoli orange. Lateral margin of mesonotum and pleura with fine golden hairs, being sparse on pleura. Pleurotergite with long fine yellow proclinate hairs. Posttegula orange-yellow, black-haired. Haltere orange, becoming brown-orange towards capitellum. *Legs:* Orange-yellow. Coxae femora, fore and mid tibiae and metatarsus yellow-haired; hind tibia black, black-haired with a few yellow ventral hairs subapically. Hind metatarsus brownish orange, yellow-haired with a few basal black hairs. Remainder of hind tarsus missing. Fore and mid tarsi with segments 1 and 2 yellow-haired. Fore tarsus with segments 3-5 brownish, yellow apically and basally; black-haired. Mid tarsus with segments 3-5 yellow, black-haired. *Wings:* Hyaline. Veins orange-yellow. *Abdomen:* Orange-yellow, black-setose, but narrowly with golden-yellow setae along lateral margin. Sternites with golden-yellow hairs. Tergites 2-5 with a black-brown transverse band basally (fig. 40). *Hypopygium* (Figs 45-47) deep black-brown, black-setose.

♀: similar to ♂, except as follows:

Head: Height 0.74-0.75 width; frons at narrowest point 0.09 head width; relative widths of frons: at narrowest point 1; at vertex 1.6-1.8; at antennae 2.1-2.4. *Legs:* Tarsi orange-brown, black-haired dorsally, orange ventrally. *Abdomen:* Cerci brownish black, black-haired.



Figs 42-47. *Ptecticus* sp. (42-44) *P. substitutus* sp. n.: (42) cerci, proctiger and epandrium, dorsally; (43) hypopygium, laterally; (44) dististyle and hypandrium, ventrally; (45-47) *P. eximius* sp. n.: (45) cerci, proctiger and epandrium, dorsally; (46) hypopygium, laterally; (47) dististyle and hypandrium, ventrally.

DIMENSIONS: Body length, ♂ 11.2 mm, ♀ 8.8-9.5 mm; length of thorax, ♂ 4.0 mm, ♀ 2.8-3.0 mm; wing length, ♂ 10.8 mm, ♀ 7.3-8.5 mm.

MATERIAL EXAMINED: *Holotype* ♂: SOLOMON ISLANDS: SAN CRISTOBAL: Kira Kira, 0-50 m, 10.xi.1964, R. Straatman, Malaise trap (BPBM).

Paratypes: 2 ♀, same data as holotype except 15 and 20.xi.1964 (BPBM).

P. eximius can be separated from *P. substitutus* by the presence of dark transverse abdominal bands and male genitalia and from *P. complens* by the narrower black transverse abdominal bands and the orange-brown hind tarsus. Some specimens of *P. substitutus* have indications of transverse abdominal bands, but are formed by dense areas of short black setae. In no specimen of *P. substitutus* is the banding as strong or as well defined as in *P. eximius*.

The male terminalia of the two species are very similar, although the epandrium and cerci of *P. eximius* are much shorter than *P. substitutus*. Also the dististyle of *P. eximius* lacks the characteristic apical expansion of *P. substitutus*.

This species is closely allied to *P. substitutus*, also from the Solomons, and appears to occur only on San Christobal at the southernmost end of the Solomons. *P. substitutus* has been recorded from all the large islands in the Solomons except for San Christobal.

ACKNOWLEDGEMENTS

I would like to thank Dr J. A. Tenorio, Bernice P. Bishop Museum, Hawaii; Prof M. T. James, Washington State University, Washington; Dr T. van Leeuwen, Zoologisch Museum, Amsterdam; Dr D. H. Colless, C.S.I.R.O., Canberra and Mr G. F. Gross, South Australian Museum, Adelaide, for the loan of material; Mr K. G. V. Smith, British Museum (Natural History), London, for kindly studying the types of *P. complens* and *P. repensans*, as well as camera lucida drawings; and Dr D. K. McAlpine, Australian Museum, Sydney, for assistance in many ways.

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THE CARBONIFEROUS BRACHIOPODS *PODTSHEREMIA PRIMA* FROM THE U.S.S.R., AND *PODTSHEREMIA AUSTRALIS* FROM EASTERN AUSTRALIA

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ABSTRACT

This report redescribes the Russian brachiopod *Podtsheremia prima* Kalashnikov based on topotype material sent to the author by Dr. N. V. Kalashnikov. *Podtsheremia australis* n. sp. a new Carboniferous spiriferid brachiopod from eastern Australia is also described. *Podtsheremia? thomasi* Roberts and *Podtsheremia? humilicostata* Roberts are confirmed as belonging to the genus *Podtsheremia*.

INTRODUCTION

The genus *Podtsheremia* Kalashnikov 1966 was first used in relation to Australian brachiopods by Roberts in 1971 (p. 216-217) for two species of spiriferids from the Bonaparte Gulf Basin in Northwestern Australia (*P.? humilicostata* Roberts and *P.? thomasi* Roberts). It is difficult to use the genus with confidence, because of the poor quality of reproduction of photographs in the Russian literature, and the lack of detail in the descriptions.

While studying Carboniferous spiriferids of eastern Australia the author encountered *Podtsheremia* sp. (Roberts, 1975) from the Chichester Fm. (Crane & Hunt, in press) in New South Wales. To ascertain the exact relationships with *Podtsheremia*, it was necessary to examine topotypes of *Podtsheremia prima*. Dr. Kalashnikov graciously sent me eight topotype specimens of *P. prima* from the Podcherem River in the Ural Mts. The descriptions of the external features of *P. prima* and the accompanying photographs should clarify the interpretation of the genus.

Podtsheremia sp. (Roberts, 1975) has been assigned to the genus and has been named *Podtsheremia australis* n. sp. *P.? humilicostata* Roberts, and *P.? thomasi* Roberts from the Bonaparte Gulf Basin are confirmed as belonging to the genus *Podtsheremia*.

Family: *Spiriferidae* King, 1846

Genus: *Podtsheremia* Kalashnikov, 1966

Type Species: *Podtsheremia prima* Kalashnikov, 1966 from the Tulska horizon, (Visean), Kirpich-Kyrta, Podcherem River, Northern Urals, U.S.S.R., by original designation of Kalashnikov, 1966. (Fig. 2; numbers 1-4).

Diagnosis: (from Kalashnikov, 1966, pp. 50-51, translated by Mrs. G. A. Cooper).

Shells of medium size. Hinge line shorter than the greatest width. Ears rounded. Sinus triplicate — with a median rib. Ribs flatly convex, numerous. On the flanks they branch and form fascicles of 2 or 3 ribs. Microsculpture is in the form of fine longitudinal stria (difficult to distinguish) and fine concentric lines of growth. Delicate teeth and delthyrial plates appear a few millimetres from the tip of the beak. A delthyrial plate is preserved for about half of the delthyrium. The shell is thin, apical filling is absent. In the dorsal valve are a wide cardinal process, high crural plates and a short septal ridge. (Roberts, 1971, p. 216-217).

Description of *Podtsheremia prima* based on examination of topotype material.

Records of The Australian Museum, Vol. 32 No. 19, 589-596, Figures 1-3.

Shell biconvex, hinge line nearly greatest width, cardinal extremities rounded; ornament of 40-50 rounded costae, most of which increase by bifurcation and trifurcation, near the cardinal extremities costae remain simple, fasciculation not obvious. Pedicle valve umbo curved slightly over hinge line, interarea moderately high, concave, with triangular delthyrial opening. Sinus broad, shallow, containing up to 30 costae at the commissure, all of which increase by bifurcation and trifurcation; a median costa is surrounded by costae on either side which split into six; the next 4 or 5 costae all bifurcate; in some specimens the floor of the sinus becomes elevated forming a median hump towards the commissure; the sinus-fold area also may become elongated, forming a 'tongue' at the margin, (Fig. 2;).

Internal features have not been observed in the Russian material.

Thin ventral adminicula are the only internal features observed in the Russian material.

Age: Visean

Material: 8 partially decorticated specimens.

Podtsheremia australis sp. nov.

Podtsheremia sp. Roberts, 1975 p. 50.

Diagnosis: Shell biconvex, subtrigonal, hingeline less than greatest width, cardinal extremities rounded, ornament of 30-50 rounded costae, all of which increase by bifurcation or trifurcation. Micro-ornament of fine radial lirae and concentric growth lines. Pedicle valve slightly more convex than brachial valve, umbo slightly curved over hinge line; hinge denticulate; interarea moderately high, concave. Sinus wide, shallow, containing a simple median costa and bordering costae which split into five or six costae either side of the median (Figs 1, 3). Similar pattern on fold. Delthyrial cavity unthickened, thin ventral adminicula, no teeth preserved, muscle field shallowly impressed, costation pattern visible on internal surfaces. Brachial valve interior possesses small sockets which flank a striated cardinal process.

Type specimen: F.59831, The Australian Museum, Sydney. (Fig. 3. no. 4).

Type locality: 90-6 (Roberts, 1975) from the Chichester Fm., N.S.W. also at 88-3, 103-2.

Age: Early Carboniferous (Visean).

Range: *Delepinea aspinosa* Zone to *Rhipidomella fortimuscula* Zone.

Fig. 3: nos. 1-7

Material: numerous specimens of molds and casts of both external and internal features.

REMARKS: The obvious differences between *P. prima* and *P. australis* are the size of the shell and the coarseness of costation. Both of these characters vary considerably at the specific level. Differences in the internal structures are difficult to ascertain, since we can not examine these features on the topotype material and must rely on the translations of Kalashnikov's descriptions. Kalashnikov mentions delicate teeth and delthyrial plates appearing a few millimetres from the tip of the beak. No teeth have been observed on the Australian species (due to poor preservation?) and there are no delthyrial plates. It is possible that Kalashnikov is using the term 'delthyrial plates' in reference to the ventral adminicula present in the pedicle valve. Kalashnikov also describes 'a delthyrial plate' preserved for about half the delthyrium. This was not observed in the Australian species.

The character taken to be of generic importance is the pattern of costation in the sinus and fold. This pattern is consistent among individuals of each species, and is remarkably similar between the Russian and Australian species. Similarity in ornamentation, which should be consistent among members of the same genus, allows the assignation of other species to the genus *Podtsheremia* Kalashnikov to be verified.

Podtsheremia? humilcostata Roberts and *Podtsheremia? thomasi* Roberts both have sinal patterns similar to *P. prima* and *P. australis*. *P. humilcostata* which is more transverse and smaller than *P. australis*, has a different sinal pattern in which the first costa on either side of the median splits into three, not five or six. *P. thomasi* resembles *P. australis* having a nearly identical sinal pattern.

A thorough discussion of the affinities of the genus *Podtsheremia* with overseas genera is given in Roberts (1971) and need not be repeated here. New light has been shed on the relationship of *P. australis* and *Spirifer duplicicostus* Phillips. Roberts (pers. comm.) reports that the type specimen of *S. duplicicostus* Phillips (1836) now housed in the British Museum bears little resemblance to the illustrations but is similar to the Australian species of *Podtsheremia*. On the type specimen the first four or five bundles of costae on each lateral slope are in triplicate, and the remainder in duplicate. There are no simple costae. This pattern on the flanks coincides with that found on *P. australis*, but not with that of *P. prima* which has simple costae towards the cardinal extremities.

Roberts reports that the sinal pattern of *S. duplicicostus* consists of a median costa which trifurcates at about $\frac{1}{2}$ the length of the valve, and five lateral costae which arise by splitting towards the posterior. This is different from the simple median costa usually in members of the genus *Podtsheremia*. Rarely a *P. australis* specimen with a bifurcating median costa has been found.

The sinal costation pattern of *Podtsheremia* is similar to that found in *Neospirifer campbelli* and *Neospirifer semilis* from New South Wales. (Roberts, Hunt & Thompson, 1976). The pattern in these species consists of a median costae surrounded by costae which bifurcate twice to form four costae on either side. The overall appearance of *Podtsheremia* is similar to *Neospirifer*. *Podtsheremia* may be an intermediate form between *Spirifer* and *Neospirifer*.

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Specimens, including the holotype of *Podtsheremia australis*, will be housed at the Australian Museum, Sydney.

TABLE OF DIMENSIONS

Podtsheremia prima

AM No.	Width (cm)	Length (cm)
F.59838	3.56	3.00
F.59840	3.80	3.18
F.59839	2.57	2.51
F.59836	3.29	2.80
F.59837	4.34	2.72
F.59835	3.36	2.39

Podtsheremia australis

AM No.	Width (cm)	Length (cm)
F.59828	2.10	1.45
F.59829	2.10	1.80
F.59830	2.40	1.70
F.59831	1.86	1.42
F.59832	2.10	1.21
F.59833	3.04	1.43

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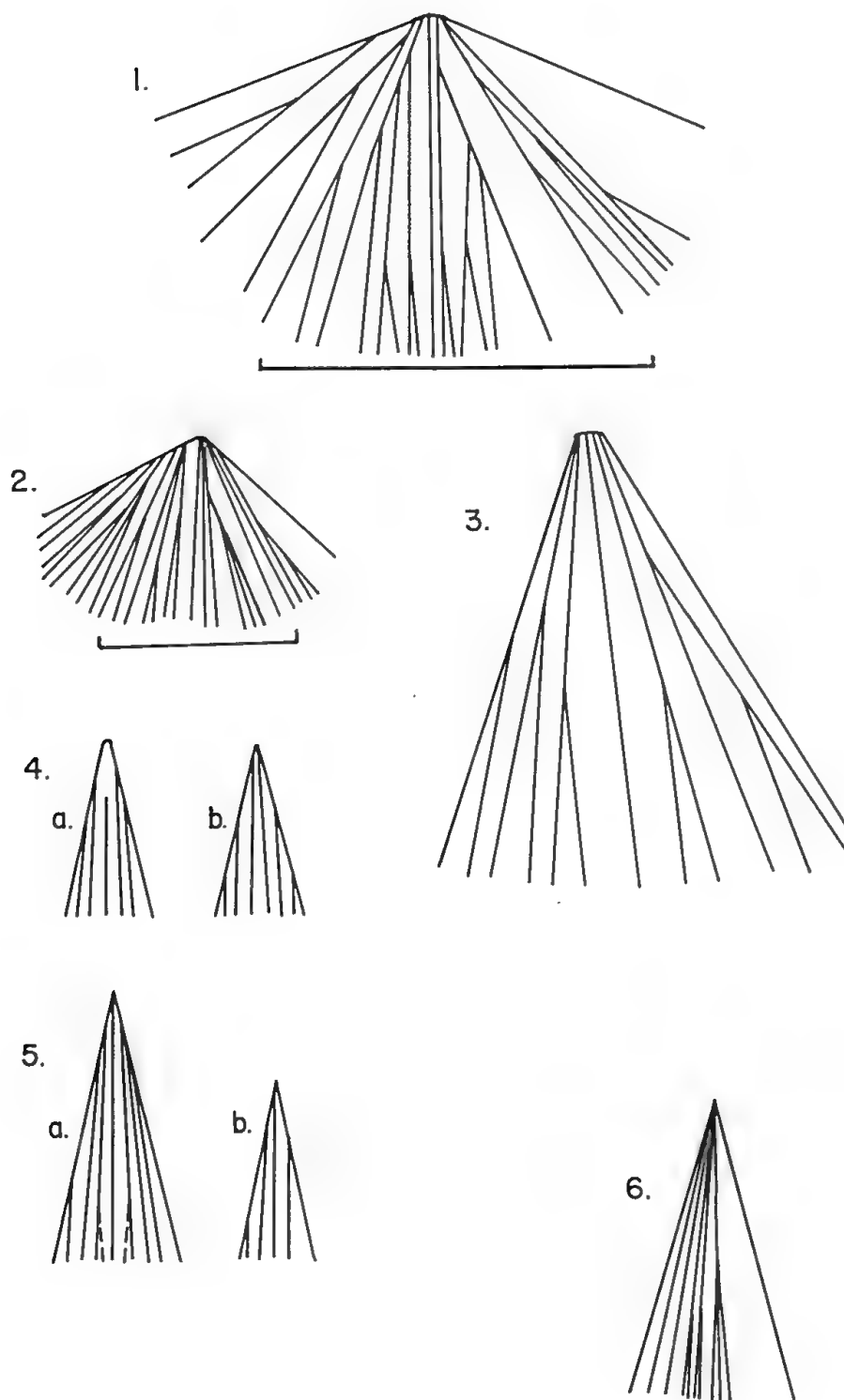


Figure 1. SINAL COSTATION PATTERNS 1. *Podtsheremia prima*, first lateral costa splits into six, median remains simple. X2; 2. *Podtsheremia prima*, first lateral costa splits into five. X1; 3. *Podtsheremia australis*, unsymmetrical sinal pattern, one lateral costa splits into five, the other into six. X4; 4. *Podtsheremia humilicostata*, (a) sinus, first costa splits into three, (b) fold pattern X1.5 (Roberts, 1971); 5. *Podtsheremia thomasi*, (a) sinus, pattern similar to *P. australis* (b) fold pattern X1.5 (Roberts, 1971); 6. *Spirifer duplicicostus*, median trifurcates, first costa splits into six or seven.

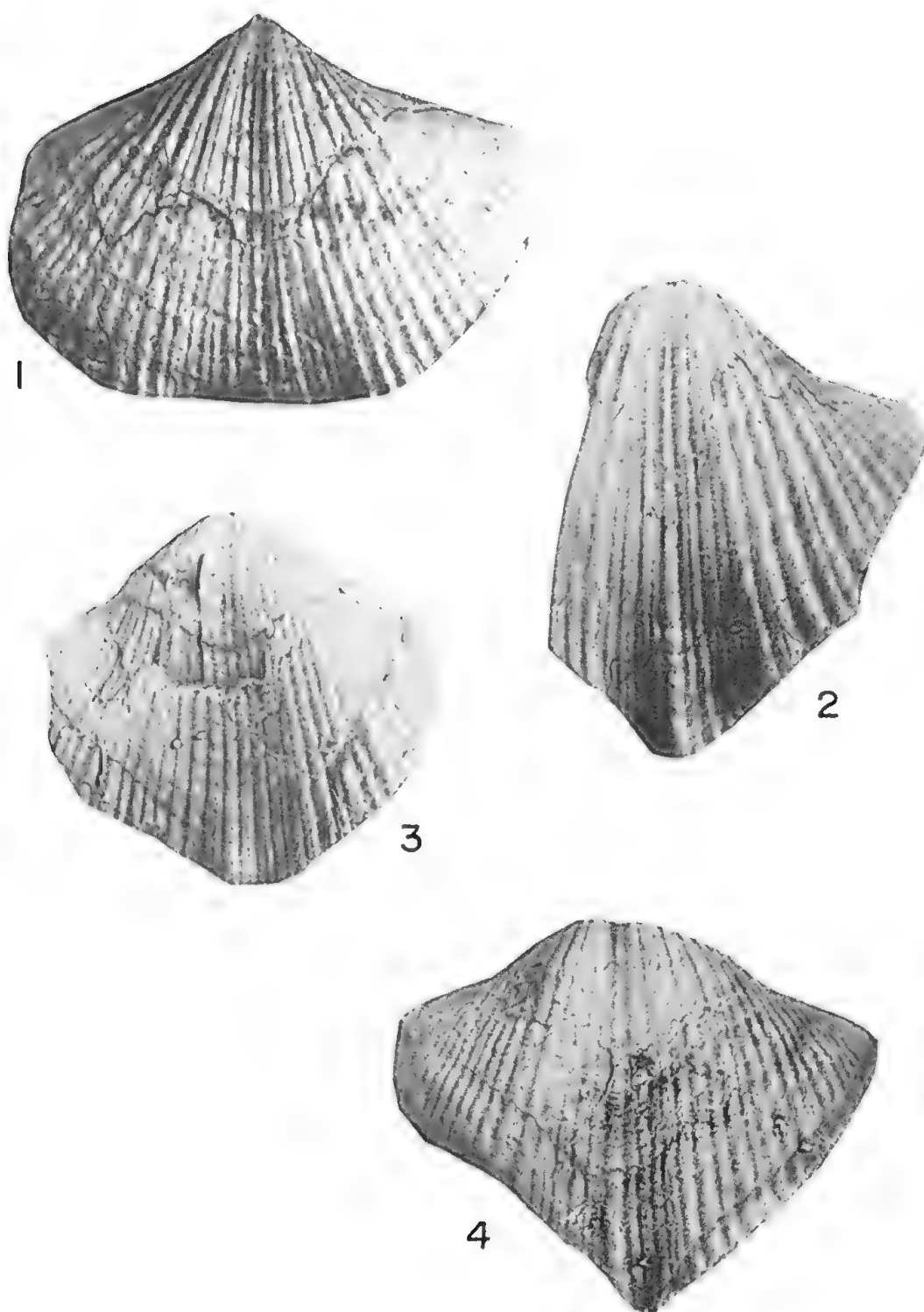


Figure 2. *PODTSHEREMIA PRIMA* Kalashnikov 1. *Podtsheremia prima*, exterior pedicle valve. X2. AM F.59838; 2. *P. prima*, exterior pedicle valve, note sinistral costation pattern and 'tongue' at sinistral margin. X2. AM F.59840; 3. *P. prima*, exterior pedicle valve, X2. AM F.59839; 4. *P. prima*, exterior pedicle valve, X2. AM F.59836.

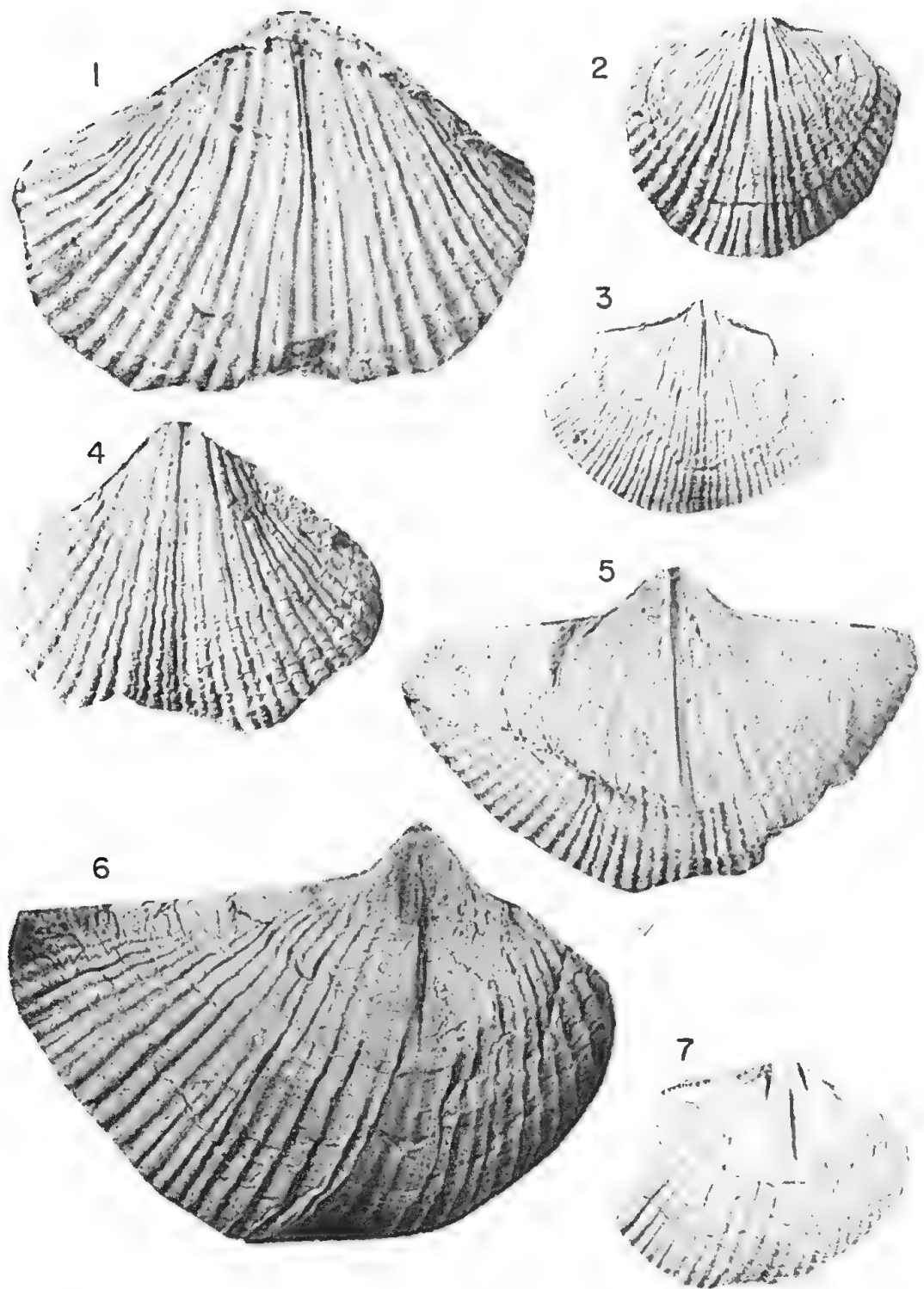


Figure 3. *PODTSHREMIA AUSTRALIS* N.SP. 1. latex cast of pedicle valve exterior, X4, Loc. 90-6, AM F.59828. Paratype; 2. brachial valve interior, X2, Loc. 90-6, AM F.59829. Paratype; 3. pedicle valve interior, X2, Loc. 88-3, AM F.59830. Paratype; 4. latex cast of pedicle valve exterior, X3, Loc. 90-6, AM F.59831. Holotype; 5. latex cast of pedicle valve exterior, X3, Loc. 88-3, AM F.59832; 6. latex cast of pedicle valve exterior, distorted, (4), Loc. 103-2, AM F.59833a; 7. pedicle valve interior, note denticulate hinge line, X2, Loc. 103-2 AM F.59833b.



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